THURSDAY, DECEMBER 25, 1919.

THE PROFESSION OF CHEMISTRY.

The Profession of Chemistry. By Richard B. Pilcher. Pp. xiv + 199. (London: Constable and Co., Ltd., 1919.) Price 6*s.* 6*d.* net.

THE late Sir Henry Roscoe, in his autobiography, relates that when he had made up his mind to follow chemistry as a profession his decision caused astonishment and even dismay among his friends and relations, who asked him if he intended to open a shop with red and blue glass bottles in the window. This, he added, was not an extraordinary question in the early 'fifties. Some persons would consider it as not more extraordinary to-day. Fairly well informed people have gradually learned to understand that there is a distinction between the professional chemist and the pharmacist, but the general community still regards the shopkeeper who dispenses medicines and sells drugs and anything else that he thinks may appeal to his clients as a chemist, because he calls himself such. This needless confusion in the public mind exists nowhere else in Europe, and would not exist here if our Legislature and the Public Departments concerned with the issue of Royal charters, and, it may be added, our lay Press, were better acquainted with the functions and aims of the science of chemistry as distinguished from the art and craft of pharmacy.

An eminent foreign physicist, passing through one of our country towns in company with the writer of this review, chanced to see, on the facia of the local druggist, the term "Family Chemist," whereat he was considerably astonished and perplexed. The appellation was wholly unintelligible until it was suggested, as the only way of escape from a laboured explanation, that it might possibly mean a "chemist with a family." As he glanced in turn at the heterogeneous objects in the window—the photographic appliances, hot-water bottles, weed-killers, toilet soaps, electric torches, safety razors, vanishing cream, egg-preservatives, hair-brushes and sponges—and commented on the character of the show-cards his wonder grew. Why a man who dealt in such articles should term himself a *chemist* was incomprehensible to a fellow-countryman of Scheele, who, by the way, always called himself an *Apotekare*; and, further, why the *soi-disant* chemist should advertise himself for the purposes of business as "a family man" was still more inexplicable, unless, as was surmised, he considered it as some justification for his charges. But he was evidently a man of enterprise, since, in addition to his other activities, he traded in spectacles and sheep-dips, sold British and foreign wines, developed photographs, and was the local agent of one of the smaller insurance companies.

That the misunderstanding as to the true vocation of a chemist is widespread is the common experience of teachers when consulted by the parents of boys who have developed a taste for scientific chemistry. The "man in the street," as a rule, has a very hazy idea of the department of knowledge or of human activity with which chemistry is concerned. He cannot be wholly ignorant of its applications, but he seldom knows them as such. Even generally well-informed people are unaware what the profession of chemistry comprehends. It is to meet this lack of knowledge that the registrar and secretary of the Institute of Chemistry has been induced to put together this book.

In a special chapter Mr. Pilcher deals with the claim of pharmacists to the title "chemist," and shows how it has arisen. They base it apparently on the teaching of Paracelsus—no very reputable authority—that "the true use of chemistry was not to make gold, but to prepare medicines." But chemistry was studied, as an art, long prior to the fifteenth century, and was applied to industry and manufacture by the ancient Egyptians and Far Eastern nations centuries before the Christian era. Many of the earliest chemists, it is true, were physicians, and practised their art, like Paracelsus, in connection with their profession. But there was never any exclusive association of chemistry with medicine, and there is no justification, therefore, for the vendors of drugs on this score to assume the title of chemist. Strictly speaking, the pharmacists are the direct descendants of the Apothecaries, who in their turn were descended from the thirteenth-century Spicers, who dealt in galenicals —*i.e.* roots, herbs, and other vegetable products. The Apothecaries gradually took upon themselves the functions of the physicians, whilst the drug-vendors usurped those of the Apothecaries in preparing and compounding medicines. The Apothecaries were originally incorporated with the grocers, and down to the beginning of the reign of James I. such drugs and medicines as were then in use were sold in common by the grocers. In 1617 the Apothecaries obtained their charter, which enacted that the grocers should no longer keep an Apothecary's shop, and that no surgeon should sell medicines. The Society of Apothecaries then proceeded to take action against the frauds and artifices of the grocers and drug-vendors, and established a manufactory of medicinal preparations for the use of their own members. Although Robert Boyle drew a clear distinction in his writings between chemists and the druggists or druggsters, as he indifferently calls them, by the middle of the eighteenth century the popular confusion was such as to draw forth a protest from Berkenhout, who complained that "persons, who know nothing more of chemistry than the name, naturally suppose it to be a trade exercised by shopkeepers called *Druggists* and *Chemists*, who are thought to be chiefly employed in preparing medicines. . . . Chemistry, therefore, they imagine belongs exclusively to physic."

Space will not permit us to follow Mr. Pilcher's historical account in further detail, but it is interesting to note that it was only after the Chemical Society was established in February, 1841, that

the "Chemists and Druggists" began to organise themselves, and "at a public meeting of the Trade held at the Crown and Anchor Tavern on April 15th" of the same year, it was resolved "that for the purpose of protecting the permanent interests, and increasing the respectability of Chemists and Druggists, an Association be now formed under the title of the Pharmaceutical Society of Great Britain."

Notwithstanding the various Pharmacy Acts, it cannot be seriously contended that the pharmacist has established any prior or prescriptive rights to the title "chemist." Scientific chemists existed in this country long before 1852, and were so termed: we have only to name Boyle, Black, Priestley, Cavendish, Dalton, Davy, and Wollaston in proof of this fact; pharmacists themselves could only designate such men as *chemists*, but they were in nowise pharmacists or druggists. Perhaps, therefore, the pharmacists would still further increase their respectability by dropping their pretensions to a title to which they have no valid right.

The chemist, properly so-called, will find little in Mr. Pilcher's book with which he is not already familiar, or will not wholly agree. The work, indeed, is not specially addressed to him. It is primarily intended for those who intend to take up chemistry as a profession, and to practise ultimately either as a consultant or as an analytical chemist, research chemist, or works chemist, or who seek to enter one of the Government Departmental or Municipal Laboratories, etc., and on leaving school wish to begin the necessary training. The book may be recommended to parents and also to schoolmasters, who are often the best judges of a boy's aptitudes, but, from their lack of knowledge of the many openings that chemistry affords, and of the proper course to pursue in order to enter the profession, are at a loss to offer sound advice.

Mr. Pilcher has a pleasant literary style; his book is eminently readable, and contains many facts of general interest. It is not often that he will be found tripping, but the sentence at the bottom of p. 120 concerning the appointment of Medical Officers of Health as Public Analysts requires amendment. Certain of the lines have apparently been transposed either in the galley or during the paging of the book.

FLOWERING PLANTS AND FERNS.

(1) *A Dictionary of the Flowering Plants and Ferns.* By Dr. J. C. Willis. (Cambridge Biological Series.) Fourth edition, revised and rewritten. Pp. xii+712+iv. (Cambridge: At the University Press, 1919.) Price 20*s.* net.

(2) *The Living Cycads.* By Prof. C. J. Chamberlain. (University of Chicago Science Series.) Pp. xiv+172. (Chicago: The University of Chicago Press; London: Cambridge University Press, 1919.) Price 1.50 dollars net.

(3) *British Ferns and How to Identify Them.* By J. H. Crabtree. Pp. 64. (London: The Epworth Press: J. Alfred Sharp, n.d.) Price 1*s.* 6*d.* net.

(1) IN the fourth edition of his "Dictionary of the Flowering Plants and Ferns," Dr. Willis has achieved the ideal form in arrangement, the sweeping together of the whole of the material into one alphabetical sequence. Part i. of the original edition, a somewhat sketchy and unequal account of the morphology, natural history, taxonomy, distribution, and economic uses of the phanerogams and ferns, has been eliminated, and the gain of space has been usefully employed in enlarging the scope of the main portion of the work. Dr. Willis claims that he has now found it possible to include all the genera, and though the expert in taxonomy may note a few omissions, the general botanist or student for whom the work is intended will not be critical on this heading. The book is, in fact, a remarkable compendium of botanical information, including not only the genera, which are referred to their family, and accorded some descriptive matter varying from a bare statement of geographical distribution to a paragraph, but also the families, which are treated in detail according to their relative size and importance. A useful feature is the inclusion of a great many popular names of plants and a large number of botanical terms, though the latter are much more exhaustively treated in Dr. Daydon Jackson's classic work. There are also a few general articles, such as one on "Collecting," and on concepts such as the leaf, inflorescence, fruit, etc., in which numerous cross-references are given to other headings.

There are occasional suggestions that the author might perhaps have spread his net a little more widely for his sources of information; and a brief list of standard works of reference, such as Dr. Jackson's "Glossary of Botanic Terms," Britten and Holland's "Dictionary of English Plant Names," and others, might with advantage have occupied one of the blank spaces at the beginning or end of the volume.

(2) The little volume entitled "The Living Cycads" is one of the University of Chicago Science Series, which aims at providing a medium of publication intermediate between the short article of the technical journal and the elaborate treatise; the volumes are written not only for the specialist, but also for the educated layman. Prof. Chamberlain has travelled round the world in order to study in their native habitats the widely separate genera of this group, remarkable for the peculiar habit, form, and structure of the plants, and for their great botanical interest as the surviving remnants of a line which reaches back through Mesozoic into Palæozoic times. During the last fifteen years the author has spent long periods of study in Mexico, Cuba, Africa, and Australia, and the work in the field has been continued in the laboratory by himself and his pupils. The subject-matter is divided into three

parts. Part i., "Collecting the Material," gives an eminently readable account of the different genera and species in their homes, illustrated by some excellent photographs. It will interest the educated layman as well as the botanist. Part ii., "The Life History," is a concise account of the Cycads in their various stages, including vegetative structures, reproductive structures, fertilisation, and the embryo and seedling. It is written with great clearness and is also well illustrated, but the mere educated layman will not get far beyond the first chapter. In part iii., "The Evolution and Phylogeny of the Group," we pass from the record of fact to speculation. This will interest the botanical student, who will follow easily at any rate the development of the different types of female sporophyll from the foliage-leaf, while he will be struck with the comparative uniformity of the male cone throughout the group. The evolution of the gametophyte and of embryogeny presents greater difficulty. Botanists will look forward to reading the much more extended technical account of the living Cycads on which the author has been at work for many years; and the results of this work will be of the greatest interest to those who are investigating the evolution and phylogeny of the Gymnosperms.

(3) Mr. Crabtree's little book on the British ferns makes a delightful introduction to their collection and study. The habitat and form are described in twenty-eight species (about three-fourths of the British species), and each description is accompanied by a full-page photographic reproduction of the plant as it grows and of a portion of a fertile leaf showing the sori on the pinnæ. The latter are sometimes wanting in clear definition. An introduction gives a very brief account of the life-history of a fern, and also directions for collecting, drying, and mounting. The author recommends mounting in a book. This was the custom in the old herbaria, but the plan of mounting on separate sheets which may be kept in a box or portfolio is much to be preferred. It allows intercalation of additional specimens or replacement of old ones, as well as alterations in arrangement, all of which are impracticable with the book-form.

OUR BOOKSHELF.

Ireland: The Outpost. By Prof. Grenville A. J. Cole. Pp. 78. (London: Oxford University Press; Humphrey Milford, 1919.) Price 3*s.* 6*d.* net.

A BRAVE and poetic effort is here made to present what Vidal de la Blache would call the personality of Ireland. The country is viewed as an outpost of Eurasia, from which her people and her civilisation have been derived in successive and overlapping waves. Prof. Cole's name assures the picturesque interest of the structural sections, and the maps and views are most helpful. A laudable effort is also made to set forth the present state of the problem of the peopling of Ireland, and this chapter is a welcome change from the too common fanciful remarks about Celts. No two writers would make the same sketch on this subject, and several would dissent from Prof. Cole's identification of the archæologically named Beaker folk with the "Bronze age" invaders of Ireland and with the monuments of New Grange. Nevertheless, Prof. Cole has made a suggestive summary that may well make a basis for discussion. The very short mention of Roman times and of the days of the saints is a little disappointing perhaps, as the story of those days emphasises the initiative of Ireland.

Separate accounts of the barrier of Leinster and the Irish plain, the uplands of the north and the Armorican ranges of the south, are full of interest with many a picturesque phrase and much fine human sympathy. The section on exits and entrances and communications hints at future developments of train ferries and of trans-Atlantic services from the West, while it gives a fresh criticism of the railway system.

The book should promote a more sympathetic understanding of Ireland's problems, and must be useful to the student and teacher, as well as to the general body of British citizens.

H. J. F.

British Rainfall, 1918. On the Distribution of Rain in Space and Time over the British Isles during the Year 1918. By Hugh Robert Mill and M. de Carle S. Salter. The Fifty-eighth Annual Volume. Pp. 242. (London: Edward Stanford, Ltd., 1919.) Price 10*s.*

TABULAR matter of great precision and of considerable scientific value as recorded by about 5000 observers constitutes the bulk of the information set out in this volume. The British Rainfall Organisation is to be congratulated on the high standard of the work which for the last time is produced under practically private management. Dr. H. R. Mill, after acting as director of the Organisation for nearly twenty years, has given over the control, which has now passed to the Meteorological Office.

An article on the development of the British Rainfall Organisation since 1910 shows considerable activity in the production of rainfall maps. A series showing the annual rainfall of the British Isles from 1865 to 1914, on a scale of nineteen miles to an inch, has been completed. A map on the scale of half an inch to a mile, showing the relation of rainfall to geographical features, is stated to be in contemplation.

Mr. Carle Salter contributes an article on "The Relation of Rainfall to Configuration," and he deals with the physical processes of rain formation.

Rainfall maps are given for each month, showing the actual fall in inches and the percentage of average. A coloured map shows the relation of rainfall in 1918 to the average of 1875–1909. The rainfall was more than 30 per cent. above the average in Merionethshire, Central and North Lancashire, North Dumfriesshire, and part of co. Kerry. The areas of deficient rainfall during 1918 occurred chiefly in the east of Great Britain.

C. H.

LETTERS TO THE EDITOR.

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Polarisation of Light Scattered by Helium Atoms.

ABOUT a year and a half ago I published an experimental investigation of the *degree of polarisation* in the light scattered at right angles by various dust-free gases (Proc. Roy. Soc., A, vol. xcv., p. 155). I believe the results then obtained to be in the main quite correct, but there is an important point on which I have completely to withdraw what I then said. This refers to the results on helium, which was then found to behave differently from the other gases, giving much less complete polarisation than any of them. The result given was that the weak image (vibrations parallel to incident beam) had 42 per cent. of the intensity of the strong image (perpendicular vibrations). This was given on the results of two independent series of photographs, which were, indeed, obtained under conditions much more difficult than those for the common gases, but were considered at the time to give adequate evidence. I do not even now know what was wrong with them; but on repeating the work with a much improved apparatus, which it has taken many months to design and construct, I have obtained an entirely different, I might say opposite, result.

I now find no intensity large enough to be observed in the weak image, and certainly not 3 per cent. of the intensity in the strong image. It may be possible to lower this limit still further; but, in any case, if helium is outstanding at all, it is in the direction of polarising more, and not less, completely than the generality of gases. The details will be published later, but I write to make the correction as soon as possible, so that no one who speculates theoretically on the subject may be misled by reliance on my former result.

RAYLEIGH.

December 21.

Gravitation and Light.

IT should perhaps be stated, in connection with Mr. Cunningham's remarks (NATURE, December 18, p. 395), that my difficulty with regard to Dr. Einstein's theory must extend to the deviation of light by the sun as well as to its change of period. According to the theory, the velocity of light *diminishes* near the sun; on the other hand, the scale of time is increased, so that the wave-length is not altered. Now, the space being nearly flat, the path of a ray is, with such heterogeneous time, determined fundamentally by minimum number of waves, and not by minimum time; therefore, it should not be altered.

On the other hand, passing from kinematics to dynamics, Dr. Einstein requires in another connection that light should consist of discrete bundles or *quanta* of energy. Let it also be granted that inertia and gravitation are attributes of all energy. It seems to follow that each of these bundles of energy will swing round the sun in a hyperbolic orbit, and that its velocity will be *increased* when near the sun. It is well known that this would account for half the observed deflection. But, again, physical optics could not exist without the idea of transverse waves and their phases, which must be grafted on somehow to the bundles of energy. Now the supposed gravitational derangement of the fourfold extension from the flat being very slight, it can be agreed that the change in extent of each element of it is of the second order. The expansion of scale of time near the sun requires thus a compensating shrinkage of radial lengths; and this second-order effect, the cause of the adjustment for Mercury, will, on the phase-principle of Huygens, just double the previous result. This would amount in all to the observed deflection of the rays.

But amid these uncertainties and apparent contradictions the view asserts itself that the very important astronomical determination is to be regarded as a guide towards future theory rather than as the verification of the particular theory which suggested it.

JOSEPH LARMOR.

Cambridge, December 20.

Radio-activity and Gravitation.

IN connection with the interesting letter of Prof. Donnan in NATURE of December 18, it may be of interest to mention some experimental results which have a bearing on this question. Some years ago Dr. Schuster suggested to one of us that it would be of interest to test whether the rate of transformation of radio-active substances was influenced by the intensity of gravitation. An accurate method of testing the rate of decay of radium emanation over a period of about a hundred days was developed, and it was intended to compare the rate of decay of samples which had been transported to suitable portions of the earth's surface. The outbreak of the war interfered with this plan.

Since, according to Einstein's theory, a gravitational acceleration is in no sense different from a centrifugal acceleration, experiments have been performed in the Cavendish Laboratory to test whether the rate of decay of radio-active substances is affected by subjecting them to the high centrifugal acceleration at the edge of a spinning disc. For the purpose of measurement the γ-ray activity was determined by a sensitive-balance method. Although the radio-active material was subjected to an acceleration of more than 20,000 times gravity, the change observed, if any, was certainly less than one part in a thousand.

This result is not in disaccord with the relation deduced by Prof. Donnan, for a simple calculation shows that his relation predicts an effect very much smaller than can be detected by measurements of this character.

E. RUTHERFORD.
A. H. COMPTON.

Cavendish Laboratory, December 19.

Mortality among Snails and the Appearance of Blue-bottle Flies.

THE residential parts of Calcutta are remarkably free, as a rule, from both house-flies (Musca, spp.) and blue-bottles. This is doubtless due to the excellence of the municipal sanitary arrangements, for at Sibpur, a few miles away, blue-bottles (*Pycnonoma* or *Lucilia dux*) are not only extremely troublesome in the houses, but are also probably connected with frequent epidemics of enteric, unknown in the better parts of Calcutta. For some years past I have noticed in the compound of the Indian Museum that Pycnonoma from time to time becomes relatively numerous, and on several occasions I have been able to trace the flies to their breeding-ground. This has always been the dead bodies of the snail *Achatina fulica*, the largest land mollusc in Bengal.

A. fulica, the shell of which may attain a length of at least 4 in., is not an indigenous species, but was introduced for purposes of dissection by a keen

malacologist some sixty-five years ago from Mauritius, whither it had been brought in some unknown manner from tropical Africa, its original home. Col. Godwin Austen [1] has told the story of its introduction into Calcutta, while Mr. E. E. Green [2] has published a report on its prodigious increase in Ceylon, when once its eggs had been carried (accidentally on a cabbage-leaf) into a suitable locality. Fortunately, it is largely a feeder on decaying vegetable and animal matter, and therefore does little harm to crops or gardens, and has even its value as a scavenger. Since, however, I found the maggots in the dead snails, I have noticed that the appearance of blue-bottles in this part of Calcutta invariably coincides with a heavy mortality in the mollusc, which appears to be subject occasionally to some kind of fatal epidemic and also perishes in large numbers after egg-laying at the beginning of the rainy season and during dry spells in and at the end of that season. In one instance investigated the mortality was due not to disease or weakness or to meteorological conditions, but merely to the fact that the snail was enormously abundant and that large numbers of individuals were crushed by people walking on garden paths in the evening.

I have thought these facts worth putting on record as illustrating the delicate balance of Nature and the danger of introducing apparently harmless or even seemingly beneficial animals into a new country.

N. ANNANDALE.

Indian Museum, Calcutta, November 19.

Remains of a Fossil Lion in Ipswich.

IN 1910 I discovered a rich bone-bed in a section of Stoke Hill at Ipswich, the deposit in which it occurred being 30 ft. below the surface. The results of the researches then undertaken were published in vol. xiv., part 1, of the Proceedings of the Suffolk Institute of Archæology and Natural History.

As a portion of Stoke Hill is now being cut away for railway sidings, a continuation of the same section is exposed, and with the permission and kind assistance of Mr. A. Woolford, G.E. Railway District Mechanical Engineer, I have been able to work for the past month upon it.

To the animal remains found in 1910, which included large cave-bear, mammoth, large horse, *Bos primigenius*, smaller ox, deer, and bird, I have now added teeth of the largest cave-lion yet discovered, with the exception of the Crayford specimen in the Spurrell collection. These were identified for me by Dr. Smith Woodward and Dr. Andrews, who also examined and named a large assortment of teeth and bones from the site. The list of remains is daily being added to, and a massive skull of deer, with other bones, a tooth, and an antler with a base measuring 10 in. in circumference, still await identification. The position of the tines suggests reindeer. With the help of a grant from the Percy Sladen Research Fund, I am able to continue the work with the care that it requires, and am employing special workmen for the purpose.

The question of the relation of Glacial deposits to these ancient land-surfaces is, of course, of paramount importance, especially as a small number of worked flints have been found closely associated with the animal remains. For this purpose pits are being dug to a considerable depth below our present ground-level in order to ascertain the constituents of the strata below.

NINA F. LAYARD.

Rookwood, Ipswich, December 17.

[1] Proc. Mal. Soc., vol. viii., p. 147 (1908).

[2] "Report on the Outbreak of *Achatina fulica*" in Circulars and Agricultural Journal of the Royal Botanical Gardens, Ceylon (1910).

Promotion of a Plumage Bill.

MAY I announce through the columns of NATURE the formation of a "Plumage Bill Group," designed to fight the plumage trade by means of publicity to the facts and of pressure upon the Government to bring in a Bill forbidding the importation of all birds' skins for millinery purposes, except poultry, ostrich, and eider-duck? Sir Charles Hobhouse is the president of this group; Lt.-Col. Swinburne, of 23 Eaton Place, S.W.1, its treasurer; and Mr. W. Dewar, of 8 Kenilworth Court, Putney, S.W.15, its hon. secretary. The group is in need both of funds and of assistance, and the former will be very gratefully received by the treasurer, and the latter as gratefully considered by the secretary and the committee.

We feel that a vigorous effort must be made to end the yearly massacre of the world's most beautiful and interesting species of wild bird—a massacre so merciless and extensive as seriously to threaten the extermination of a large number of species, and thus to throw out of gear the great work of evolution. Nor is there any honest or valid argument for the traffic, since this immense drain upon natural resources is for no other purpose than to feed the profits of a small band of East End traders and to satisfy the frivolity of some women.

H. J. MASSINGHAM.

December 17.

The Deflection of Light during a Solar Eclipse.

THERE can scarcely be a downward rush of cold air in places deprived of the sun's radiation during an eclipse as suggested by Prof. Anderson. This would happen only if the upper layers of the atmosphere were cooled more than the lower, and if the cooling were sufficient to bring the temperature-gradient near to the adiabatic. As it is, however, the effect of an eclipse should be to cool the lower layers more than the upper, and so to decrease the temperature-gradient. Moreover, if cooling caused convection movements, we should have upward currents as well as downward, and a development of cumulus clouds would result from the passage of the moon's shadow.

C. J. P. CAVE.

Ditcham Park, Petersfield, December 19.

INDUSTRIAL RESOURCES OF INDIA.[1]

AS explained in a preface by Sir Thomas H. Holland, the president of the Indian Munitions Board, this handbook was originally prepared in connection with the exhibit of the Board at the exhibitions held in Bombay and Madras in the winter of 1917–18. It was intended to show what had been done to develop India's industrial resources for war purposes. It has now been enlarged so as, in some measure, to indicate the general industrial development which has taken place during, and on account of, the war, and it discusses the possibility of future progress.

The Board was created in 1917 with the view of relieving the United Kingdom, so far as possible, from the necessity of meeting India's demands for war purposes, and particularly for the supply of the forces in India, Mesopotamia, and Egypt. Its functions consisted not only in utilising Indian resources to the utmost extent, but also in controlling and regulating imported

[1] Indian Munitions Board. Industrial Handbook, 1919. Revised Edition. (Calcutta: Superintendent, Government Printing, 1919.) Price 2s. 3d.

material so as to avoid waste and overlapping on the part of different departments of the public service.

After a short account of the history and organisation of the Board and of its relations to indigenous industries, we have a series of reviews of industrial development in Bengal, Madras, Bombay, the United Provinces, the Punjab, Burma, and the Central Provinces. The book then deals with specific industries, viz. the chemical and metallurgical industries; the future of hydro-electric power in India; electrical and engineering manufactures; hides, tanning, and leather; tanstuffs and tannin extracts; the supply of timber and bamboos; textiles; shipbuilding; railway material; petroleum; calcium carbide; paper-making; paints; glass; the coconut industries of the west coast of the Madras Presidency; soap; bitterns; Portland cement; lac; glue and gelatine; industrial alcohol; medical and surgical appliances; jute, hemp, and flax; pine resin; magnesite and mica; hardware; sandalwood oil; and it concludes with an account of miscellaneous articles purchased by the Indian Munitions Board, and a description of the Tata iron and steel works at Jamshedpur (Sakchi).

With regard to the reports of development in the several presidencies and provinces, each has been entrusted to a member of the Indian Civil Service, usually the Director of Industries or the Controller of Munitions. With one exception, all tell the same story of the strong stimulus which has been given to native industry by the war. "It has taught India its dependence on other countries and the danger of such dependence," writes Mr. Peterson; "it has tended to make the Presidency (Madras) more self-supporting and less dependent on the United Kingdom"; while it has arrested temporarily the development of some industries, it has opened up new possibilities, and diverted energy into new channels (Mr. Innes); Mr. Mead reports that the cotton mills in Bombay, Ahmedabad, and other places in the Presidency have prospered exceedingly during the war; glass-works have been established, and there have been considerable increases in the export of castor, ground-nut, and sesamum oils, and of castor and ground-nut cake; large quantities of casein are being exported, mainly to the United Kingdom and America, and the industry is rapidly extending; chemical manufactures have been established, with the result that many products formerly imported are now made successfully in India. There has been a great development in the utilisation of indigenous timber, and the ample deposits of suitable clays have been turned to increasing account in the production of tiles, bricks, and pottery. Mr. Silver states that "the war has given a strong stimulus to various industries in the United Provinces. The mills and factories of Cawnpore have been engaged almost entirely on war work," working continually, night and day, providing the many woollen and cotton items required for Army purposes. In spite of the very large call for men for the Army, "the Punjab has undoubtedly developed some of its industries very considerably" during the war, writes Mr. Townsend. This is especially seen in the manufacture of textiles, wood and metal work, cutlery, glass, leather, and certain minor industries. The Controller is sanguine that "the experience gained by many thousands of unskilled labourers in the manufacture of useful articles will prove to be not without its value to them after the war." "The effect of the war in developing industries in Burma was less marked than in some other Indian Provinces," reports Mr. Hardiman. This was due partly to its distance from war theatres, but mainly to the small extent to which its raw material is worked up owing to the shortage and high cost of labour, the lack of cheap fuel, and the paucity of roads and railways. The chief assets of Burma are its exportable surplus of rice; the large area of its reserved forests; its minerals and oil-bearing regions. Burma is largely undeveloped, but it has evidently great possibilities; at present it suffers from lack of capital and the reluctance of the Burman to submit to the discipline of an organised industry.

The effect of the war on the industrial development of the Central Provinces has, in the opinion of Mr. Corbett, been adverse, owing, he thinks, to the depletion of staffs both in the Government service and in private employment, the impossibility of recruiting experts, the difficulty of procuring machinery and stores, and the shortage of fuel and of transport. It has retarded the growth of agriculture, and has not permanently benefited forestry. On the other hand, the collection of tanstuffs has undoubtedly derived great impetus from war demands, and has been put on a more scientific and permanent basis. Cement and pottery works are now established as very profitable industries, but a number of smaller industries have suffered from the lack of expert supervision and the impossibility of obtaining adequate plant.

The general impression one derives from the reports of the provincial controllers is confirmed and amplified by the reports of the experts on the present condition and future prospects of the main industries of India. These latter reports constitute a very valuable feature of the book, and are of great interest. We would specially indicate the detailed account of the chemical industries of India by Profs. Sudborough and Simonsen; the report on the metallurgical industries by Dr. Leigh Fermor; that on the leather industry and on tanstuffs by Mr. McWatters and Mr. Fraymouth; on petroleum by Mr. Watt; on Portland cement by Messrs. Musgrave and Davy; and the several reports on lac products, glue and gelatine, and industrial alcohol by Dr. Gilbert Fowler, of the Bangalore Institute of Science. Lastly, we would refer to the account of the Tata iron and steel works at Sakchi (Jamshedpur) by Mr. Tutwiler, the general manager. These were started in 1912. They are on a very large scale, properly organised and laid out, and fitted with

modern appliances and labour-saving machinery. They are being rapidly extended and developed, and are certain to exert a profound influence on the industry of the East, not only in India, but also in Ceylon, Java, Manchuria, China, Japan, Australia, the United States, the Argentine, etc., with all of which countries they are building up an export trade in iron and steel castings, machinery, fencing wire, nails, tools, galvanised products, tinplate and enamel ware, etc. An interesting feature is the description of what is being done to promote the intellectual and physical well-being of the workers by the provision of hospitals, convalescent homes, schools, co-operative stores, credit societies, an industrial bank, a concert hall, a restaurant, a reading room, etc.

There can be no question that India is on the eve of most momentous changes, political, social, and industrial—changes which have been largely affected and accelerated by the war. All who are interested in her future will do well to study carefully this official account of her present industrial position. It will amply repay perusal.

THE REFORM OF THE CALENDAR.

THOSE who have concerned themselves with the question of a reformed calendar will find much interesting matter in a report[1] published by a committee which was appointed early in the year by the Paris Société d'Encouragement pour l'Industrie nationale. In 1884 the Abbé Croze, chaplain of La Roquette prison, suggested a competition of schemes to M. Flammarion's journal, *L'Astronomie*, and presented anonymously prizes to the value of 5000 francs, with the rather incompatible conditions that the first day of the year should be always a Sunday, and that the week of seven days and the year of twelve months should be retained. From that time until the outbreak of war, enthusiasts had been making proposals, and, though they had reached little agreement among themselves, they had succeeded in 1910 in inducing the International Congress of Chambers of Commerce at London to pass a resolution in favour of reform, and the Swiss Government to promise diplomatic action. The projects have been reported from time to time in these columns. Since the close of the war, proposals of the kind have been renewed, and the report of the French committee is a useful document.

For the Western world there are two calendars of importance existing. There is the Gregorian calendar and there is the ecclesiastical calendar, founded on the Council of Nicea, which rules the movable festivals of the Churches. Hence there are two quite distinct questions before the reformers. One is to remove the conventional luni-solar element from the latter, and to fix Easter so far as possible relative to the Gregorian calendar. Another is to reform the Gregorian calendar itself, more or less drastically. But yet a third plan has been proposed by a French engineer, M. Paul Delaporte, which consists practically in ignoring these questions and in using a special subsidiary calendar purely for the purposes of industry.

The French committee, under Gen. Sebert, has formulated a number of resolutions which appear sensible and on the whole conservative. This is perhaps natural, in view of the peculiar French experience of ill-considered calendars. It supports the proposal to keep the variation of Easter within the narrowest possible limits—a week instead of a lunar month. This view has the assent of all lay opinion, and it is believed that it is no longer opposed by any ecclesiastical authority. On this point agreement in detail should be reached quickly and carried into effect without delay. Another resolution favours the substitution of the Gregorian for the Julian calendar, a hope which political events may have brought nearer to realisation. On the general manner of reform the committee expresses itself in favour of the continuity of the week. This excludes at once a number of schemes, the latest of which was proposed by M. Deslandres. At the same time, it threatens to make the change so slight as scarcely to be worth making at all. But it leaves open such a possibility of a perpetual calendar as the succession of thirty-five, twenty-eight, twenty-eight days in the month, with thirty-five days in December when the date ends in 0 or 5 generally and twenty-eight days in all other years, with the addition of those dates ending in twenty-five and seventy-five and those divisible by 400. This rule is not more complicated than the corresponding Gregorian rule, and the objection lies not so much to the variation in the length of the year as to the unequal months. Of course, a symmetrical calendar is out of the question, and no change in the present system can offer serious advantage without raising some such objection and meeting with firm opposition in consequence.

M. Delaporte, mentioned above, is properly impressed with the difficulty of ousting the present calendar, and suggests his scheme as an auxiliary, not as a substitute for it. Strictly speaking, his project does not seem to be a calendar at all, because it lacks continuity. He takes the Gregorian year as he finds it, and divides it from the beginning into thirteen months of four weeks each. This is the Comtist calendar without trimmings, but the one or two days at the end of the year must be provided for "à part." He furnishes in the report different mechanical and tabular modes of exhibiting the correspondence between his scheme or "Chronos" and the Gregorian calendar for a year. He claims that the method of reckoning weeks continuously through the year has proved itself advantageous in industrial practice. It is very possible. No doubt the advantage would be increased by uniformity of practice secured by agreement over a wide area. But the ordinary diary gives for each date the number of days elapsing from the beginning of the year, and if on this basis a business man cannot divide up his year to suit the requirements of his calling, suggestions from outside will scarcely help him.

[1] "Commission pour la réforme du calendrier." Bulletin de la Société d'Encouragement pour l'Industrie nationale, tome cxxxi., p. 70.

At any rate, no scientific liability is involved if he persists in the use of the necessarily unequal calendar month when a more convenient uniform period might be substituted. The French committee approves of M. Delaporte's economic calendar for its own special purposes, and recognises that it stands apart from the question of a civil calendar properly so called. H. C. P.

NOTES.

PROMINENCE has been given in the daily papers to an interview with Dr. J. O. Arnold, who has recently resigned from the chair of metallurgy at the University of Sheffield, relating to a new alloy tool-steel, the cutting powers of which are claimed to be far in advance of those of any rapid-cutting tools at present in the market. The element conferring this property is stated to be molybdenum. It was reported in the interview that Dr. Arnold had taken out British and American patents, but that, owing to the veto of the War Office, the Admiralty, and the Ministry of Munitions, he was not allowed to exploit his discovery, and that he was forbidden to communicate its details except under censorship to anyone in Great Britain. Meanwhile, representatives of the United States Government were said to be conducting inquiries in Sheffield. On December 19 it was announced, however, that Dr. Arnold had received notice from the Government that the restrictions had been removed. Until more information is forthcoming as to the precise chemical composition of the steel tools in question it will be well to suspend judgment on the matter. That rapid-cutting tools can be made with molybdenum as the alloy basis has been known for many years. Such tools, however, have hitherto been regarded as peculiarly sensitive to heat conditions, and therefore liable to injury by improper treatment. This has stood in the way of their exploitation in practice.

MORE than ninety years ago alcohol was synthesised from ethylene gas by Hennel. The gas was absorbed in sulphuric acid, with which it combined to form ethyl hydrogen sulphate. On distilling this with water alcohol was obtained in the distillate. Until recently the process has remained a purely laboratory operation. During the war, however, investigations were made into the practicability of utilising for the commercial production of alcohol the small proportion of ethylene present in the gas given off from coke-ovens. A good deal of progress was made and the possibility proved, but the process was not fully worked out. It appears that this has now been successfully accomplished. In a paper read at a meeting of the Cleveland Institution of Engineers, Middlesbrough, Mr. E. Bury, of the Skinningrove Iron and Steel Works, states that practical working has given a yield of 1·6 gallons of alcohol per ton of coal carbonised. The best results were obtained by absorbing the ethylene at a temperature of 60°–80° C. It is calculated that the coal used for coke-making in this country would yield more than 23,000,000 gallons of alcohol yearly, and the ethylene present in ordinary coal-gas, if similarly treated, would supply a further 27,000,000 gallons.

WE have received from the Royal Statistical Society a copy of a petition which has been forwarded to the Prime Minister urging the immediate appointment of a Royal Commission or Select Committee to inquire into the existing methods of the collection and presentation of public statistics and to report on the means of improvement. The lack of co-operation between the different Departments charged with the preparation of statistics, and the consequent lack of co-ordination between their publications, excellent though these are in many respects, and the absence of any sufficient information on points that are now of the first importance (*e.g.* wages, incomes, and home production), are so notorious that some action in the direction indicated is most urgently called for. Adequate information is the very basis of right reform, but in scarcely any case is it forthcoming. The petition received the most widespread support from members of both Houses, from learned societies, from county and municipal authorities, and from those interested in social questions and the use of statistics generally—support which will, we hope, secure its acceptance.

THE Electricity Supply Bill has had many vicissitudes in its passage through Parliament. In its final form it elicited little opposition, if no great enthusiasm. The appointment of Commissioners is universally welcomed. They can do much to co-ordinate the working of new schemes, and can effect great economies by standardisation. They will erect one or two superstations which will effect an economy of fuel. They will probably also use a certain number of internal-combustion engines, which, theoretically at least, have a higher economy than steam turbines. The appointment of district boards with powers of compulsory purchase was strongly opposed by the electric supply companies, mainly on the ground that it was a breach of the Parliamentary bargain made in 1888. It was pointed out that electric supply was initiated by private enterprise, and that many of the pioneer companies had an anxious and unremunerative time in their early days. To take away the opportunity they had of bettering their financial position in the few remaining years of their concession was not just. The Government, influenced by the strong opposition to the suggested district boards, and possibly also by the approach of the end of the session, dropped all the contentious proposals. There is now a golden opportunity for the companies, both private and municipal, to enter into combination as "joint electricity authorities" for themselves, and it would be good policy for them to make a move in this direction, but at present we see no signs of such a movement. The proposals for district boards, which were all thoroughly discussed in Committee, will doubtless be revived either in this or in a future Parliament.

THE report of the Council of British Ophthalmologists on the desirability of a special qualification in ophthalmology presents a strong and well-considered case. The qualifications required by the principal hospitals of candidates for the post of ophthalmic surgeon—usually the fellowship of the College of Surgeons of England, Edinburgh, or Ireland—furnish no evidence of special knowledge of ophthalmology. The council concludes that there should be a special examination for those who propose to devote themselves to this branch of medicine; and that, owing to the importance of a sound knowledge of the general principles of surgery, pathology, etc., this examination should form part of the examination for a higher degree or diploma, such as the M.S. or F.R.C.S., rather than that it should be a special examination in ophthalmology alone. The council rightly lays stress upon an exhaustive curriculum, including anatomy, pathology, optics, systematic and clinical ophthalmology, and operative surgery. The Council of British Ophthalmologists is doing excellent work in striving to improve the teaching and practice of ophthalmology. It has already reported upon the teaching of these subjects to undergraduates, the lighting of test types, and other matters. It deals

with aspects of medicine which are not catered for by the ordinary medical societies, but are of great importance to medical men in their relationship to the general public. It is eminently desirable that the excellent example which the council has set should be followed by other branches of medicine.

THE last day of this year marks the bicentenary of the death of John Flamsteed, first Astronomer Royal of England, and the rector of the parish of Burstow, Surrey, where he is buried, uncommemorated, we understand, by any monument. Flamsteed was born four years after Newton, and was a native of Derbyshire, being the son of a well-to-do maltster. Though prevented by illness from attending a university, he was devoted to mathematical studies, and in 1671 sent a paper to the Royal Society. Three years later he published his "Ephemerides," a copy of which, being presented to Charles II. by Sir Jonas Moore, led to Flamsteed being appointed on March 4, 1675, "our Astronomical Observer" at a salary of 100*l.* per annum, his duty being "forthwith to apply himself with the most exact care and diligence to the rectifying the tables of the motions of the heavens and the places of the fixed stars, so as to find out the so much desired longitude of places for the perfecting the art of navigation." The observatory at Greenwich, constructed partly of brick from old Tilbury Fort and of timber and lead from the Tower of London, was designed by Wren and built at a cost of 520*l.*, the money being derived from the sale of spoilt gunpowder. The struggles and disputes, the dogged perseverance, and the memorable achievements of Flamsteed have their place in the history of astronomy, but it may safely be said that never has king or Government made a better investment than when Greenwich was built and Flamsteed made passing rich on 100*l.* a year.

AT the general meeting of the Association of Economic Biologists on December 10 and 11 more than seventy new members were proposed, and Sir David Prain was elected president for the forthcoming year. Exhibits were made by Messrs. W. F. Bewley, E. E. Green, A. D. Cotton, and W. B. Brierley. Papers were read by Mr. W. F. Bewley on "Sleepy Disease, or Wilt of Tomato," Mr. W. E. Hiley on "A New Instrument for Measuring the Light Intensity in Woods," and Mr. F. R. Petherbridge on "The Life-history of the Strawberry Tortrix, *Acalla comariana*." December 11 was devoted to a symposium on "The Integration of Mycological Research with Practice in Agriculture, Horticulture, and Forestry." Sir Daniel Hall discussed the administrative problems involved and the organisation which the Board of Agriculture proposes in this connection. The training of investigators was treated by Prof. V. H. Blackman. The special needs and difficulties of agriculture were dealt with by Dr. E. J. Russell, of horticulture by Mr. F. J. Chittenden, and of forestry by Prof. W. Somerville. Sir David Prain discussed the part which the newly formed Imperial Bureau of Mycology will play in linking the investigator with the practical man. The meeting was presided over by Prof. F. W. Keeble, and in the discussion following the principal speakers a large number of members took part. The symposium was of great value in co-ordinating many divergent lines of thought, and there can be little doubt that the more frequent adoption of this method at scientific meetings would be conducive to that synthesis which is so great a desideratum in all natural science.

AN interesting and valuable gift which has more than a local interest has just been received by the Plymouth Institution. This is the fine vase presented to Sir William Snow Harris in 1845 by the Emperor Nicholas I. of Russia. Harris, who was born in Plymouth and educated at the Grammar School there, was trained as a doctor in Edinburgh, and for a time practised in his native town. After his marriage in 1824, however, he abandoned his profession to devote himself to the study of electricity. From 1819 onwards he was a frequent lecturer at the Plymouth Institution, where in 1822 his subject was "The Application of Fixed Conductors to Ships' Masts." In 1827 the Lord High Admiral—afterwards William IV.—while on a tour of inspection to the dockyards, visited the institution, and with some naval officers witnessed Harris's experiments. Two years later a Royal Society committee under Davy reported favourably on the proposals, but it was not until 1839, when the matter was referred to another committee, that Harris's new conductors were introduced into the British Navy, although the Russian Navy was already using them. The Copley medal had been given to Harris in 1835, and other honours followed. He was awarded a Civil List pension in 1841; the Emperor of Russia gave him a valuable ring and the vase in 1845; two years later he was knighted, and the Government afterwards made him a grant of 5000*l.* He died in the house overlooking the Hoe in 1867, and his name is inscribed on one of the panels in the Plymouth Guildhall. Harris's fixed conductors replaced the temporary conductors introduced by Watson in 1762, and led to a great diminution in the loss of ships through lightning. His scientific work and his improvements are a notable instance of the benefits conferred upon the community by local scientific societies, and no fitter place for the preservation of the beautiful vase presented to Harris could be found than the institution which saw the birth of his discoveries.

IT is announced in *Science* that Dr. Frank Schlesinger, director of the Allegheny Observatory of the University of Pittsburgh, has been elected director of the Yale Observatory.

THE Physical and Optical Societies' annual exhibition, to be held on Wednesday and Thursday, January 7 and 8, 1920, at the Imperial College of Science, South Kensington, will be open both in the afternoon (from 3 to 6 p.m.) and in the evening (from 7 to 10 p.m.). Prof. F. J. Cheshire will give a discourse on "Some Polarisation Experiments" at 8 p.m. on January 7 and at 4 p.m. on January 8, and Prof. A. O. Rankine will give a discourse on "The Use of Light in the Transmission and Reproduction of Speech" at 4 p.m. on January 7 and at 8 p.m. on January 8. Admission in all cases will be by ticket only, obtainable by members of various societies through the secretaries. Others interested should apply direct to the Secretary of the Physical Society, National Physical Laboratory, Teddington, S.W.

THE weather of the past autumn was so abnormal that a few facts concerning it are worth recording. At Greenwich for the whole autumn the mean temperature was 47·7°, which is 3·0° below the normal. There are only three autumns in the last hundred years with lower means—46·8° in 1829, 47·4° in 1840, and 47·0° in 1887. The autumn rainfall was 3·23 in., which is 49 per cent. of the average. There have been only two autumns in the last hundred years with a smaller rainfall—1834 with 2·84 in., and 1858 with 2·80 in. October was the driest month of the year with the exception of May, whereas it is normally the wettest of the twelve months. From October 26 to November 16 inclusive, twenty-two days, the maximum temperature at Greenwich was

below 50°, and from November 10–16, seven days, it was below 40°. There has been no similarly long period without a temperature of 50° at the corresponding time of year during the last seventy-eight years. This cold period was due to an abnormal distribution of atmospheric pressure, the barometer being high over Iceland and the neighbourhood, whilst it was low to the south-east and south of England, causing a steady drift of cold north-east and east winds over the British Isles.

In the Journal of the Bihar and Orissa Research Society for September last Mr. M. H. Shastri discusses the contributions of Bengal to Hindu civilisation. In the religious sphere western Bengal was the scene of origin of Buddhism and Jainism. It was the aborigines of Bengal who taught the Vedic Aryans how to tame the elephant and to manufacture silk and cotton cloth. It was from the local performances of mystery plays that the Indian theatre was founded in Bengal. The writer's views in some instances may be open to comment, but the article is an interesting contribution to Indian history.

We have received the annual report of Livingstone College for the year 1918–19. The college gives training in elementary medicine, surgery, and hygiene to missionaries going to spheres of work abroad far from medical aid. During the war the college was transformed into an auxiliary hospital, but has now resumed its proper work. The fees of students do not suffice to cover expenses, the deficit being met by donations, and further donations to the college funds are urgently needed.

In the *Quarterly Journal of Experimental Physiology* (vol. xii., No. 3) Sir E. Sharpey Schafer shows that the fatal result of section of both vagus nerves is due not to pneumonia, resulting from absence of sensation in the parts supplied by these nerves and lack of protection from foreign matter entering the lungs, but to paralysis of certain muscles of the larynx, leading to obstruction of the glottis and slow asphyxia. If this obstruction is prevented, animals live indefinitely with scarcely any abnormal symptoms. In the same journal Prof. Halliburton points out that the waves in the blood-pressure seen during asphyxia are correctly designated as "Traube" waves. Those described by S. Mayer are of a different nature, and being artificial have no physiological significance.

The *Veterinary Review* for November (vol. iii., No. 4) provides a valuable summary of literature on current veterinary science and practice. Among the reviews is one giving a full *résumé* of the methods employed in the examination of milk at the Intercommunal Laboratory at Brussels, with details of the method of scoring. A maximum of 150 points is given for all kinds of milk, and samples of sterilised and pasteurised milk must obtain not fewer than 120 points; aseptic raw milk, 115 points; and ordinary milk, 100 points. The scoring is based upon number of bacteria present, catalase test, reduction test, fermentation test, microscopic characters of films, and kind of bacteria present.

The Thomas Vicary lecture on "The Surgical Tradition" was delivered in the Royal College of Surgeons of England on December 3 by Sir John Tweedy. In 1646 Mr. Edward Arris, and in 1655 Mr. John Gale, gave sums of money to the Company of Barbers and Surgeons for the purpose of lectureships. In 1745, on the dissolution of the union between the Barbers and the Surgeons, these funds became vested in the Surgeons, and afterwards in the Royal College of Surgeons, and "Arris and Gale" lectures have been delivered ever since 1810. Early in the present year the Barbers' Company founded a lectureship at the Royal College of Surgeons to perpetuate the memory of Thomas Vicary, Master of the Barbers' Company in 1540, and the former association between the Barbers and the Surgeons. Sir John Tweedy, who is a past-president of the Royal College of Surgeons and a past-master of the Barbers' Company, first reviewed the life of Vicary, who was Serjeant-Surgeon to Henry VIII., Edward VI., Mary, and Elizabeth, and also resident surgical governor to St. Bartholomew's Hospital. Sir John Tweedy then surveyed the progress of surgery from the period of Egypt and Greece, dealing in succession with the times of Celsus and Galen, the Arabian writers, Lanfranc and Ambroise Paré, concluding with a notice of Dr. J. F. D. Jones, who discovered the true principles of the ligature of arteries in 1805.

Some very interesting notes on the migration of birds over the Mediterranean Sea, by Mr. C. Suffern, appear in *British Birds* for December. The author holds that there are at least three main routes of migration, apart from the Gibraltar line. One of these runs from Cape Bon to Sardinia, Corsica, and the Riviera. Another from Egypt to Crete and Greece. The third seems to run from Africa to Malta, Sicily, and Italy.

Mr. M. A. C. Hinton, in the *Scottish Naturalist* for November-December, describes a new species of field-mouse from Foula, thus adding another to the list of insular forms which have been brought to light by an intensive study of these northern islets. The Foula field-mouse (*Apodemus fridariensis thuleo*)—one of the *Apodemus sylvaticus* group—most nearly resembles the field-mouse of Fair Isle, from which it differs in its smaller size and conspicuously larger feet. Very carefully prepared tables of external and internal measurements enable an exact comparison to be made with other British species of the *sylvaticus* group.

The 1918 Report of the Agricultural and Horticultural Research Station, Long Ashton, Bristol, states that, as is the case with all such stations, the normal work has been considerably interrupted owing to war conditions, and its place has been taken by technical and advisory work, as well as by some few instruction courses for officers. This outside work included investigations into the utilisation of cider-fruit by the jam trade and for other purposes, miscellaneous experiments in connection with fruit and vegetable preservation, and an extensive series of experiments on potato-spraying for the prevention of potato disease. The last-named experiments include investigations into the use of Burgundy mixture and of other copper sprays, and discuss what proportions of soda and copper sulphate are most advantageous in the former mixture. The normal experimental work with cider for the season 1917–18 had to be reduced considerably, and the varieties tested were those which had been examined in former years. The trial orchards for cider-production have received rather scant attention, though some new orchards have been added. Other work includes the study of "reversion" and resistance to "big bud" in black currants; the preserving value of various spices and essential oils; the influence of concentration of sugar solutions upon the growth of micro-organisms; as well as a large amount of advisory work and several special investigations which arose out of it.

Some improvements on his well-known classification of climates are proposed by M. W. Koppen. A summary of his suggestions, without a map, is given in

Revue générale des Sciences for October 15. The three main divisions are tropical or *zone mégathermique*, temperate or *zone mésothermique*, and cold or *zone microthermique*. These are based on considerations of temperature. Two other divisions are placed on the same level, one embracing hot deserts and the other cold deserts, but in their case amount of precipitation is an important determining factor. Subdividing these zones, M. Koppen finds eleven principal climates, which he names as follows: (1) Tropical forests, (2) savannas, (3) steppes, (4) deserts, (5) temperate with dry winter, (6) temperate with dry summer, (7) temperate humid, (8) cold with wet winter, (9) cold with dry winter, (10) tundra, and (11) perpetual ice. In addition to these main climates M. Koppen recognises a large number of secondary and transition climates. With the help of these lists he gives two or three reference letters to every climate on the globe. We gather from the summary that he distinguishes some fifty different climates. Thus the climate of Brisbane is indexed as *Cfa*, which designates a warm temperate climate with rainfall at all seasons, and the mean of the warmest month not above 22° C. Cairo is indexed BW*h*, which means an arid climate of the desert type, with a mean annual temperature above 18° C.

IN a paper read before the London Mathematical Society in 1903 Sir Joseph Larmor showed that when the disturbance propagated into a medium is determined by considering each element of an advancing wave-front to constitute a source of disturbance, as Huygens did two centuries ago, the problem of finding the strengths of these sources was indefinite from an analytical point of view. Many distributions could be found over the wave-front which would give the same total effect. In a further paper read before the society on November 13 Sir Joseph shows that, although analytically the problem is indefinite, physically one specification only is permissible.

IN the *Biochemical Journal* for November Prof. W. D. Halliburton and Messrs. J. C. Drummond and R. K. Cannan describe some experiments made to ascertain the food value, if any, of the synthetic product prepared from olive oil and mannitol by Lapworth and Pearson. The synthetic oil possessed a taste and odour recalling those of olive-oil, but somewhat less pleasant; insufficient oil was at hand to make experiments on the higher animals, so rats were employed in the work described. From the results so obtained Halliburton, Drummond, and Cannan conclude that "mannitol olive-oil" is utilised by the animal organism practically to the same extent as olive-oil itself, and no toxic action was observed to follow its prolonged administration to rats.

A SHORT account of the methods used in France at the present time for the production of radium bromide and other radio-active substances is given by M. Demenitroux in *La Nature* for November 1. Pitchblende from Joachimsthal being no longer obtainable, the industry is dependent on carnotite from Colorado, autunite from Portugal, and certain rare-earth minerals from Madagascar. These contain fewer than 15, and in some cases not more than 4, milligrams of active material per ton. The first operation consists in the separation of the barium, and this process is a long and costly one. The radio-active materials are separated with the barium, and the second operation is the separation of the two from each other. This is done by fractional crystallisation, a tedious but certain process which involves, as a rule, 500 successive crystallisations of the material. Finally, one of the tubes used in medicine containing 100 milligrams of radium bromide is obtained from 12 tons of the ore, 3 tons of hydrochloric and 1 ton of sulphuric acid, 5 tons of carbonate of soda, and 10 tons of coal. The present cost in France of the hydrated bromide of radium, $RaBr_2,2H_2O$, is 500 francs per milligram.

HITHERTO it has been stated in the literature that chloropicrin can be distilled unchanged at ordinary pressure. Messrs. J. A. Gardner and F. W. Fox have observed, however (Journal of the Chemical Society for October), that when the pure anhydrous substance is distilled at atmospheric pressure a small amount of a yellowish-red gas, resembling diluted nitrous fumes, is invariably produced, and can be seen in the atmosphere of the condenser and receiver. These authors show that this is due to a slow decomposition of the boiling chloropicrin into carbonyl and nitrosyl chlorides, according to the equation

$$CCl_3.NO_2 = COCl_2 + NOCl.$$

If 200 c.c. of the substance are boiled gently, the rate of decomposition is approximately 2 c.c. per day. This observation will account for the divergence between statements made on the physiological activity of chloropicrin. Further, the experiments of Frankland, Challenger, and Nicholls, showing that under some conditions chloropicrin is quantitatively reduced to methylamine, and under others to ammonia, would be explained by the reduction in the first case of chloropicrin *per se*, and in the second of its decomposition products. In some reactions chloropicrin seems to act as a nitro-compound, *e.g.* it can be substituted for nitrobenzene in Skraup's method of preparing quinoline; whilst in others the results can be explained as due to the carbonyl and nitrosyl chlorides.

THE latest catalogue of second-hand books of Messrs. W. Heffer and Sons, Ltd., Cambridge (No. 184), comprises a number of works on history and economics from the library of the late Rev. Dr. W. Cunningham; also books on architecture and archæology, and old travels to the East.

MR. FRANCIS EDWARDS, 83 High Street, Marylebone, W.1, has just circulated a Catalogue (No. 396) of autograph letters, historical documents, and manuscripts. Many of the letters are the work of explorers and men of science. The section devoted to manuscripts contains several items of great historical value.

AMONG forthcoming books of science we notice the following:—A "Peat Industry Reference Book," the late F. T. Gissing (*Charles Griffin and Co., Ltd.*); "The Life and Inventions of Sir Hiram S. Maxim," P. F. Mottelay (*John Lane*); "Military Psychiatry in Peace and War," Dr. C. S. Read (*H. K. Lewis and Co., Ltd.*); "The Life and Letters of Silvanus Phillips Thompson, F.R.S.," Jane S. and Helen G. Thompson (*T. Fisher Unwin, Ltd.*); and "The Life of Sir William White, K.C.B., F.R.S.," F. Manning (*John Murray*).

IN reference to our notice of the *Daily Telegraph* Victory Atlas (November 13, p. 276), Messrs. Geographia, Ltd., take exception to the remark that "a mistake is made in the area of the Slesvig plebiscite." This criticism, which had reference to the course of the frontier of that area, was based on the abstract of the Treaty of Versailles published in Treaty Series, No. 4, and our reviewer wishes to examine the German large-scale maps of Slesvig before accepting the boundary shown by Messrs. Geographia, Ltd. Meanwhile, we regret if his reading of the text and maps of the abstract gave a wrong impression of the accuracy of the *Daily Telegraph* Atlas.

OUR ASTRONOMICAL COLUMN.

BARNARD'S PROPER-MOTION STAR.—It was shown in *Mon. Not.* for November, 1916, that this star was observed by Lamont at Munich in 1842, being Mun. (1) 15040. Further confirmation of this is given by K. Graff in *Ast. Nach.* (4989 and 5007). He has surveyed the region with the 60-cm. refractor at Bergedorf, and gives visual magnitudes on the Harvard scale, and colour on the Osthoff scale, of twenty-eight stars in the region. The Barnard star is of mag. 9·37 and colour 3·4, being the reddest star in the field. There are nineteen individual measures of its magnitude, ranging from 9·22 to 9·60, but they are not grouped in a manner suggesting variability. The magnitude of the star Mun. (2) 6966, which Bauschinger observed in 1886 in an unsuccessful search for Mun. (1) 15040, is 10·79 and colour 2·0. Its proper motion is small, and it must have been extremely near the Barnard star in 1843. As there was some doubt whether the star B.D. +4° 3561 was the Barnard star or Mun. (2) 6966, Prof. Kustner has re-examined the original zones at Bonn, with the following interesting result. Zone 462 was observed on 1854 May 30, the air being very clear. The following two stars were recorded in the region :—

	Mag.	R.A. 1855·0 h. m. s.	N. Decl. 1855·0 °
(*a*)	... 9·5	17 50 43·8	+4 16·5
(*b*)	... 9·5	17 50 44·3	+4 17·9

Zone 472 was observed on 1854 July 24, the air again being clear; on this night a single object was recorded in the place, thus :—

(*c*)	... 9·3	17 50 41·9	+4 17·3

In editing the B.D. it was assumed that objects (*a*) and (*c*) were the same, and their mean was taken as the position of +4° 3561, while object (*b*) was omitted as insufficiently observed. However, making use of our later knowledge, it is fairly certain that (*a*) is Mun. (2) 6966, (*b*) is the Barnard star, while (*c*) is probably the two objects observed as one (the telescope was small and the magnifying power low). This would account for the greater brightness recorded on July 24, which is unquestionably too high for Mun. (2) 6966. In view of these facts, the two stars must divide the claim to the title B.D. +4° 3561, but another early observation of the Barnard star (1854 May 30) has been established with tolerable certainty.

Mr. Graff estimates the diameter of the Barnard star as 1/20 of the sun's, or half that of Jupiter. This is based on its absolute magnitude and an estimate of its surface brightness from the character of the spectrum. It seems, however, unlikely that so small a body could ever attain the temperature necessary for a sun-like state. Prof. Eddington considered that a mass 1/8 of the sun was the minimum for the attaining of a sun-like condition. If we assume a density eight times the sun's, or twice that of the earth, this would give a diameter 1/4 of the sun's. It seems unlikely that the actual value is less than this.

THE GREAT SOLAR PROMINENCE OF LAST MAY.—Several reproductions of the photographs of this object, taken by the eclipse expeditions, have recently appeared (*Observatory*, November, and the British Astronomical Association's Journal, October). The Monthly Notices for June contained some photographs taken with the Cambridge spectroheliograph. The *Astrophysical Journal* for October gives some beautiful photographs taken at short intervals with the Yerkes 40-in. refractor. The first photograph was taken at 1h. 17m. G.M.T., about midway between the Sobral and Principe pictures. The prominence then formed a great arch, extending from −42° to +6° in latitude, and 4·5′ high. It was rising rapidly, and 1¼h. later it had broken away from its terminal columns. Successive plates show that the rising continued steadily, and at 7h. 57m. G.M.T. its height was 17′, or more than a solar radius. It rose from 200,000 km. to 760,000 km. in 6h. 40m. Mr. Evershed also secured many photographs of the object at Kodaikanal, but the longitude of Yerkes was more favourable for securing its most dramatic stage. The prominence had been in existence since March, but on the eclipse day it suddenly changed from the quiescent to the eruptive type. The Yerkes observers direct attention to a claw-like marking at the base of one of the columns, from which they infer that this base was exactly on the sun's limb.

ATOMIC DISINTEGRATION AND HEAT ENERGY.

SIR OLIVER LODGE, in the Trueman Wood lecture to the Royal Society of Arts, referred to last week, asked whether atomic energy may not already be being unconsciously utilised. The recognition of radio-activity as a process of natural transmutation, in which a large and previously unknown store of energy associated with the atomic structure is released in the disintegration of the atom and its change into totally different kinds of atoms, dates, of course, from the early years of the century. The natural conclusion is that, before this energy can be rendered available, artificial transmutation must be possible, and that this transmutation certainly does not occur in any other case than in that of the radio-elements, and then only spontaneously and in a manner not to be altered by artificial means.

Sir Oliver Lodge appears, however, to think that internal atomic energy may be being already unconsciously made use of, and cites two possible cases. The first is vision. The retina is supposed to contain a substance the atoms of which are capable of accumulating a few million impulses of æther-waves of luminous frequency. This causes the atom to eject one or more electrons, and it is these electrons rather than the original light-waves which stimulate the nerve-endings. Even accepting this as an interesting and suggestive new photo-electric theory of vision, which accounts satisfactorily for the extreme sensitiveness of the eye, the energy involved is surely the energy of the exciting radiation rather than internal atomic energy. Photo-electric effects in general are not supposed to be different from or more fundamental in character than other electro-chemical effects.

In the other example it is the energy of the electrons emitted by an incandescent wire which is in question. It is possible to welcome and recognise the very great advance which the use of this phenomenon, by means of the thermionic valve, has achieved in wireless telegraphy and telephony, without accepting the view that any new form of energy is utilised. The emission of electrons is, indeed, described as analogous to the evaporation of molecules from a surface, the velocities being distributed in accordance with Maxwell's law for a monatomic gas. It would seem sufficient to ascribe the energy of the electrons to heat energy, at least until it is proved that it is not so derived. The mere latter-day interpretation of many of the changes studied by the chemist and electro-chemist in terms of the electron does not alter their character, which is well understood by chemists not to be of the type they would regard as transmutational, or to involve the kind of energy disclosed by radio-activity, or, indeed, any other kind than what has been familiar in chemical, electro-chemical, and physical changes since these subjects began to be studied.

THE BRITISH ASSOCIATION AT BOURNEMOUTH.

SECTION M.

AGRICULTURE.

OPENING ADDRESS (ABRIDGED) BY PROF. W. SOMERVILLE, D.Sc., PRESIDENT OF THE SECTION.

DURING the past four years—or since the ploughing programme began to take shape—grass-land has been officially cold-shouldered in no small degree. The cause was obvious and the reasons were good. The result of compulsory and voluntary ploughing has been that, whereas in 1914 the total area in Great Britain under temporary and permanent grass (hay and pasture) was practically 21,500,000 acres, it was barely 19,500,000 acres in 1918, a reduction, namely, of about 2,000,000 acres. During the same period the arable area, other than temporary grass, increased from about 10,500,000 acres to 12,500,000 acres. In Ireland during these years the area under grass (permanent and temporary) fell from about 12,500,000 acres to less than 11,250,000 acres. The United Kingdom at the present time comprises about 30,500,000 acres of permanent and temporary grass and 15,500,000 acres of land under crops other than grass and clover. This is over and above some 16,000,000 acres of mountain land used for grazing.

A considerable proportion of the grass-land of this country is of so high a quality that any improvement, and certainly any economic improvement, is hard of accomplishment. Satisfactory as are the high-class pastures of this country, it by no means follows that there is nothing more to learn about them. It is often very difficult to determine the factor or factors that go to the making of high-class pastures. Such pastures are to be found on most of the geological formations of this country; they are met with north, south, east, and west; and even altitude, within the limit of at least 700 ft., seems to have little effect. An immense amount of attention has been given to the botanical composition of the herbage of the more famous of the pastures of Britain. The result that emerges most conspicuously from these researches is that one may have a dozen pastures which are about equal in feeding value and yet may vary widely in respect of botanical composition. Thus Fream found that in the case of forty-eight English and eight Irish pastures, each of which was the "best" in the district selected, the Gramineæ might be as low as 11 per cent. and as high as 100 per cent.; Leguminosæ might be entirely absent or as high as 38 per cent.; while of miscellaneous herbage, most of which would be designated as "weeds," there might be none or up to 89 per cent. As regards individual genera and species, Fream found, for instance, that Agrostis was almost always present, and on five occasions was the most abundant plant; while *Holcus lanatus* gave an almost identical result. By a different method Carruthers arrived at a very similar conclusion. The latter also found that *Hordeum pratense* was the most abundant species on what is perhaps the finest grazing in England, namely, Pawlett Hams, near the mouth of the Parret, in Somerset. This investigator even found that on one of the "famous ancient pastures of England" the predominant grasses were Fiorin and Hassock, and in this connection makes the following remark, "In this field the hassock-grass, which made up a large proportion of the pasture, was freely eaten, and the cattle were in good condition."

In Hall and Russell's investigations Agrostis and Holcus might on occasion each exceed 20 per cent., and it is stated that "wherever *Holcus lanatus* occurs it is more abundant on the fatting fields." Even miscellaneous herbage could bulk more than 29 per cent. on a pasture so good that it could fatten five bullocks on four acres without cake. Armstrong found in a field representative of "the richest type of old grazing land found in the Market Harborough district" that, amongst grasses, *Poa annua* came second (12·3 per cent.) in point of abundance. There will be general agreement that four of the grasses just mentioned, Fiorin, Yorkshire Fog, Squirrel Tail, and Hassock, are accounted "bad," and yet it is hard to apply this term to plants which are the most abundant constituents of some of the finest pastures in England. While there is much that is disconcerting in these investigations, some facts do emerge with satisfactory consistency:—(1) That the great majority of high-class pastures contain a large proportion of perennial ryegrass and white clover; (2) that crested dogstail is almost always present, though rarely predominant; (3) that meadow fescue is practically negligible; and (4) that of the two Poas, *pratensis* and *trivialis*, the former is very rare, while the latter is very common.

The obvious deduction to be drawn from these investigations is that the quality of a permanent pasture is only in a minor degree determined by the relative abundance of its constituent plants, or, in the words of Hall and Russell, "We can only conclude that the feeding value of a pasture is largely independent of the floral type." Factors of much greater weight are depth and physical character of the soil, soil moisture and temperature, density of the herbage, and the natural or induced composition of the soil as regards plant-food, and especially in respect of phosphoric acid.

It seems that the lesson that may be learned from a study of the old pastures of England is that we need not include in a seeds mixture for permanent purposes plants which never bulk to any considerable extent in old grass-land, but that we should include all those which are usually naturally abundant. Take, as an illustration, the case of perennial ryegrass. In the eighties of last century, when much interest was taken in the subject of the best way to lay down land to grass, an almost violent controversy arose over the desirability or otherwise of including perennial ryegrass in a seeds mixture for permanent pasture. The main opponents of ryegrass were Faunce de Laune and Carruthers, who would have excluded this species in all circumstances. It is a common experience of those who have laid land away to grass with ordinary commercial seed that perennial ryegrass does not persist, but neither, for the matter of that, does white clover. And the probability is that the cause in both cases is to be found in the same direction. Both these plants, as usually grown in this and other countries for seed, are the progeny of a long line of cultivated ancestors, grown under somewhat forcing conditions which may be said to undermine the "constitution." They have adapted themselves to their artificial environment, and such adaptation has taken the form of early maturity and the production of a large yield of "bold" seed which is easily marketed. Gilchrist has, of late years, directed attention to the merits of wild white clover, which, as regards persistency, is on an altogether different plane from the cultivated or Dutch white. The price that farmers are willing to pay for the seed of wild white clover is the best proof of the sharp distinction which they draw between the two varieties. What we now want is similar work on grasses, and particularly on perennial ryegrass, and it is satisfactory to know that such work has actually been started.

Important as is the position of the fine old pastures of England in the agricultural economy of the country, and interesting though it may be to examine questions of seeding, a much more important line of inquiry is opened up by the problem of the improvement of our second- and third-rate pastures. What proportion of the grass-land of the country falls into the lower categories it is impossible to say, but the most superficial acquaintance with rural England is sufficient to carry conviction that the aggregate area of such land is enormous. Most of the poor grass-land of the country is associated with the heavier classes of soil, and has been abandoned to grass on account of the high costs of cultivation, including, in many cases, the necessity of drainage. It is, for arable purposes, essentially wheat-land, with an occasional crop of beans, and the regular intervention at comparatively short intervals of a bare fallow. Other areas of poor pasture, smaller in aggregate extent than the clays, but still of much importance, are to be found on all the geological formations of the country. Of the 14,500,000 acres of permanent grass in England and Wales, 70 per cent. is under pasture and only 30 per cent. under hay, and of the poorer classes of grass-land it is certain that the proportion that is grazed is still greater. It is evident, therefore, that the improvement of pasture is relatively a more urgent matter than the improvement of meadows, though with more than 4,250,000 acres of permanent grass made into hay in England and Wales during 1918, the latter problem is also one of enormous importance. The most famous experiments on the effects of manure on permanent hay are those started in 1856 by Lawes and Gilbert on the meadow at Rothamsted, and continued ever since on the lines originally laid down. The results have thrown a flood of light on the principles of manuring, which has been of the greatest assistance in the elucidation of problems in agricultural chemistry and soil physics. They have also shown unmistakably the effects of the more important elements of plant-food on the yield of hay and on its botanical composition, but, even supported as they were by elaborate chemical analysis of the produce, they leave us uncertain in regard to the feeding value of the herbage.

A very large number of experiments have been carried out which had for their object the determination of the quantitative results attributable to the use of manures, singly and in combination. In many cases these experiments were supported by a botanical, and not infrequently by a chemical, analysis of the resultant herbage, but it was felt that we were still in a state of much uncertainty in respect of the quality of the hay—that is to say, its effect on animals consuming it. This induced Middleton in the winter of 1900–1 to carry out a feeding experiment with sheep at Cockle Park, and in 1905–6 and 1907–8 Gilchrist continued and amplified this work. The sheep were accommodated in a special house. The various lots of sheep all got equal quantities of roots, cake, and hay. The hay employed was the produce of variously manured plots on old grass-land which I laid out in 1897. The soil is a clay loam on a boulder clay subsoil. This set of experiments includes the eight-plot test, and it may be interesting to see what influence nitrogen, phosphoric acid, and potash respectively have on the produce. The quantitative figures refer to the average annual yield for twenty-one years, 1897–1917, while the figures which indicate the relative values of the produce, as determined by the live-weight increase of sheep, are based upon the feeding tests already specified. The hay from the unmanured plot, No. 6, is assumed to be worth 1*l.* per ton. The results are set out in the accompanying table:—

Plot	Manuring per acre per annum	Average annual yield of hay	Value per ton of hay as determined by feeding
		cwt.	*s.* *d.*
6	Unmanured	19¼	80 0
7	30 lb. N in Sulphate of Ammonia	23	72 0
8	50 lb. P_2O_5 usually in Basic Slag	20	93 0
9	50 lb. K_2O in Muriate of Potash...	16	80 0
10	30 lb. N + 50 lb. P_2O_5	30¼	84 0
11	30 lb. N + 50 lb. K_2O	21	72 0
12	50 lb. P_2O_5 + 50 lb. K_2O	26	101 9
13	30 lb. N + 50 lb. P_2O_5 + 50 lb. K_2O	30½	89 2

Nitrogen derived from sulphate of ammonia, and used at the rate of 30 lb. per acre per annum, has consistently increased the yield and as consistently reduced the quality. When used alone the nitrogen has increased the crop by 3¾ cwt. per acre, and reduced the feeding value of the hay by 8*s.* per ton. When added to phosphates, the nitrogen has increased the yield by 4¼ cwt. and reduced the quality by 9*s.* per ton. When nitrogen was added to potash the yield has been raised by 5 cwt. per acre, and the value lowered by 8*s.* per ton. When used as an addition to both phosphates and potash the nitrogen has increased the yield by 4½ cwt. per acre, while the value has fallen by 12*s.* 7*d.* per ton. Even if the quality of the hay be disregarded, the use of nitrogen has always been attended by an adverse financial balance; when quality is taken into account this undesirable result is greatly emphasised.

As regards phosphoric acid, an increased yield has been consistently obtained by its use, accompanied in every case by a marked improvement in the quality of the hay. Taking the arithmetical mean, the increase in quantity has been nearly 8½ cwt. per acre, while the increase in quality is represented by 16*s.* per ton.

The behaviour of potash is rather peculiar. It has quite distinctly reduced the yield when used alone or when used in combination with nitrogen only, while in both these sets of circumstances it has had no influence one way or other on the quality of the hay. When added to phosphates it has proved powerless to increase the yield, but it has raised the feeding value of the hay by 8*s.* 9*d.* per ton. When added to both nitrogen and phosphates the potash has been practically inoperative so far as yield is concerned, but it has improved the quality by 5*s.* 2*d.* per ton.

These results show that very erroneous conclusions may be reached if, in experimental work on meadow hay, attention is given only to the weights of produce secured. Thus, in these Cockle Park experiments, on the average of twenty-one years, if quantity alone be regarded, sulphate of ammonia used by itself has involved an annual loss of 6*s.* 4*d.* per acre, whereas, if the reduced quality of the hay be taken into account, the loss is increased to 15*s.* 7*d.* per acre. On the other hand, a quantitative gain of 4*s.* 2*d.* per acre per annum from the use of phosphate and potash is raised to one of 32*s.* 5*d.* owing to the superior quality of the hay. While there is a certain relationship between the chemical composition, the botanical analysis, and the feeding value of the hay, there will probably be general agreement with Middleton when he says that "without an appeal to the animal, the relative values of samples grown under different treatment cannot be measured." In my view, this form of research may, with advantage, be largely extended.

Turning now to the improvement of pastures, as contrasted with meadows, it may be remarked that while no sharp line can be drawn between these two classes of grass-land in respect of ameliorative treat-

ment, there are certain distinctions which must be kept in view. In a meadow the plants are allowed to grow up to full maturity, whereas in a pasture they are cut over daily, or at least very frequently, by the grazing of the animals. It is difficult to arrive at a decision as to whether a larger gross weight of dry material is got from a given area treated as pasture, in contrast to being hayed, but the probability is that the aggregate quantity is greater. Take the analogy of a patch of lucerne. Cut three or four times in the season, it may yield six tons of dry matter per acre, cut once it would certainly yield much less. Or take the case of cocksfoot; this springs so quickly in the aftermath that the foliage may shoot up 6 in. almost in as many days, whereas there would be no such growth were the hay not cut over. It is a matter of observation, too, how quickly red clover springs up after cutting, and trees and shrubs which may be growing only a few inches annually when unrestrained may send up stool shoots several feet in length if cut over. It is difficult, however, to bring the question to the test of figures.

If there is any doubt as to the greater weight of dry matter produced under a system of grazing, there can be none in respect of its digestibility. This would appear to be the reason why sheep and cattle will fatten on a pasture, whereas the animals would only remain in store condition on the herbage if made into hay.

At one time experiments on the improvement of pasture took the form of temporarily enclosing an area, to which different methods of treatment were applied and of determining the results in terms of hay. Supplementary to such quantitative determination, chemical analysis and botanical separations were often made, but it is evident from the work of the investigators already quoted that the results so obtained may be a very untrustworthy index of the feeding value of the herbage. In any case, the competition between the various classes of plants may be very different in a hay field and in a well-grazed pasture. Again, in a hay field the produce is reaped and cleared off with all the plant food which it contains. In a pasture, on the other hand, there is the daily conversion of vegetable substance into manure and its immediate return to the land. Reflections of that sort induced me in 1896 to arrange a series of experiments where a direct appeal was made to the animal. We all know that among a lot of animals there are certain individuals which possess idiosyncrasies which result in their thriving better or worse than the others. By careful selection, however, and especially by keeping them under observation for a probationary period, this objection may be largely eliminated. The greater the number of animals, the more completely is any disturbance due to individual peculiarities got rid of, and for this reason sheep are usually employed in preference to cattle. No one who looks into the details of these "manuring for meat" experiments can doubt that, not only in broad outline, but even in the finer details, the results are perfectly trustworthy. Involving as they do considerable outlay on fencing, water, weighing machines, etc., and necessitating the use of large areas of uniform land, such experiments were not likely to be undertaken with great frequency, but I have been able to find reports of nine in England, twelve in Scotland, two in Ireland, and one in New Zealand. Two of them are situated at Cockle Park, of which the original in Tree Field has now completed its twenty-third season, while the other in Hanging Leaves has a record of sixteen years.

The outstanding feature of these experiments is the great and profitable effect of phosphates. In this material the farmer is placed in possession of an agent of production the effects of which on the output of meat, milk, and work from the pastures of this country are only limited by the supplies. In many cases the increase of meat is trebled, and even quadrupled, with a return on the original outlay that runs into hundreds per cent. As between the various sources of phosphate there is unmistakable evidence that basic slag is the most effective, not only in respect of aggregate yield of meat, but also, and more particularly, when the net financial return is considered. This conclusion is also reached by Carruthers and Voelcker in a long series of pasture experiments carried out in 1896–99 for the Royal Agricultural Society of England. In these experiments, however, the effects were only estimated by ocular inspection. The primary effect of phosphates is due to the marked stimulus that they give to the growth of clovers and other Leguminosæ, and as these plants revel in a non-acid soil the alkaline character of basic slag appears exactly to suit their requirements.

In regard to the quantity of phosphatic manure that can most effectively be employed per acre, it would appear that in the case of inferior pasture a heavy initial dressing, say 200 lb. of phosphoric acid or more per acre, is likely to be nearly twice as effective as half this dressing, and therefore actually much more profitable. To secure the best results the Leguminosæ must be rapidly brought up to their maximum vigour, so that they may fully occupy the ground before the grasses have had time to react to the effects of the accumulated nitrogen.

One of the most striking results of these pasture experiments is the long period over which the action of phosphates persists. Even at the end of nine years the meat-producing power of half a ton per acre of basic slag is far from being exhausted. It is not suggested that this persistent action of slag—and no doubt this applies also to any other effective phosphate—is due to unappropriated residues. It is much more probably due to two other causes: (*a*) to the fact that on a pasture, in contrast to a meadow, manurial elements are kept in circulation from the soil to the plant, and from the plant to the animal, and so, to a large extent, back to the soil again; and (*b*) to the accumulation of nitrogen in the form of humus. Poor, unprofitable grass is chiefly associated with clay, and it is fortunate that it is precisely on such land that clover responds so markedly to phosphatic manuring. But conspicuous results have also been obtained on deep peat, on light stony loam, on thin chalk, and on chalk covered by clay with flints. Middleton has very fully discussed the conditions under which phosphatic dressings may be expected to give results, and ascribes an important place to soil moisture, on which white clover is directly very dependent. The only conspicuous case of failure of phosphates to improve pasture was encountered in Norfolk, where a "manuring-for-mutton" experiment was started in 1901. The soil at that station was a hot, dry, sandy gravel containing 60 per cent. of sand, and there both the basic slag and superphosphate were unable to produce any improvement. Wood and Berry attribute this result partly to the presence of abundant natural supplies of citric soluble phosphoric acid, but chiefly to lack of moisture. In reporting on the R.A.S.E. experiments Carruthers and Voelcker in 1900 had already directed attention to the dependence of basic slag on soil moisture.

We may now look at the effect of supplementing phosphates with certain other substances. And, first of all, as regards potash. At most of the manuring-for-mutton stations, both in England and Scotland,

there was a plot devoted to the elucidation of the effect of this substance, and although in the great majority of cases the phosphate-*plus*-potash plot has shown more live-weight increase than phosphates alone, it is only in very rare instances that the gain has been a profitable one. Even on thin soil overlying chalk, potash has had little action on pasture. There are several rather conspicuous instances of quite moderate dressings of potash doing positive harm. Thus, at Cockle Park, whereas potash gave an appreciable increase in live-weight in the first nine years, it proved positively and progressively injurious during the next two six-year periods. Even on a "light stony loam" in Perthshire, Wright found that, although in the first two years potash when added to slag gave a conspicuous return, in the next three years "the advantage was wholly with the slag-alone plot." The most notable beneficial effect of potash was obtained in Dumfriesshire on a station where the mineral soil was overlaid by 10 ft. of peat. There the use of kainit supplying 100 lb. of potash per acre at the beginning of the experiment has in seven years produced 70 per cent. more meat than phosphate (slag) alone, while the financial gain has been improved by nearly 50 per cent.

Potash has had great influence both on the yield and composition of the hay on the meadow at Rothamsted, and it would seem that this substance has more effect on a meadow than on a pasture. The reason is probably to seek in the fact that in a pasture the top layers of the soil are constantly being enriched by the potash brought from the subsoil by plants and returned through their excreta. In any case, pasture plants on clay soil are in possession of abundant supplies of potash, and it is only where pasture occupies sandy, gravelly, or peaty soil that this manurial element need be seriously considered.

Lime as an addition to superphosphate was tested at the three original manuring-for-mutton experiment stations, a total of 30 cwt. per acre being applied in three dressings in nine years. A noticeable effect was produced at all stations, and at two of them the gain was a profitable one. The effects of lime can be followed for twenty-one years at Cockle Park, where the soil naturally contains 0·59 per cent. of calcium carbonate. During that period an aggregate of 5½ tons per acre was applied in seven dressings, the phosphate to which it was added being superphosphate in the first nine years and basic slag in the next twelve. The area receiving the lime was the same throughout. The action of the lime has proved to be a progressively decreasing one. On the average it produced an annual increase of 22 lb. live-weight in the first nine years, and of 8 lb. in the next six years, whereas in the concluding six years of the period it has actually caused a reduction in live-weight of 8 lb. per acre per annum.

The addition to superphosphate of moderate dressings of nitrogen in the form of sulphate of ammonia or of nitrate of soda was tried at the three main manuring-for-mutton stations, and at two others. There is no need to go into a detailed discussion of the results. The evidence is overwhelmingly against the use of nitrogen on pastures. It undoubtedly stimulates the vigour of the non-leguminous herbage, but this reacts on the growth of the clovers, with the result that the production of meat is sometimes, as at Cockle Park, actually and substantially reduced.

At the three original stations dissolved bones were also tried, the comparison being with equal quantities (200 lb. per acre in nine years) of phosphoric acid derived respectively from basic slag and superphosphate. The dissolved bones supplied in addition from about 20 lb. to 40 lb. of organic nitrogen. All manures were applied as to half in the first year, and, as to the other half, at the commencement of the fourth season, the experiment being continued for nine years at Cockle Park and Sevington (Hants) and for eight years at Cransley (Northants). At Cockle Park slag acted substantially better than dissolved bones, though the latter surpassed the effect of superphosphate; at Sevington dissolved bones proved inferior to both the other manures; while at Cransley the position was reversed. But when the cost is considered there is no question of the superior merits of basic slag. This superiority is continued and emphasised at Cockle Park, where the experiments are now at the end of their twenty-third year. A similar result was also obtained in the series of pasture experiments conducted by the Royal Agricultural Society of England already referred to. There dissolved bones or bone-meal was tried at ten centres, with the result that "in Herefordshire some benefit was observed, but in the other places no real improvement could be detected as compared with the unmanured part of the field. So far as these investigations go, therefore, they indicate that no further experiments need be made with bones on pasture land."

With these results before us it is needless to pause to consider whether the comparative failure of bones, dissolved or raw, is due to the inferior quality of their phosphate or to the fact that they supply the land with nitrogen.

A form of pasture improvement which has had, and still has, much support amongst farmers is feeding with cake. The manure applied to the land through cake residues is a "general" manure, supplying nitrogen, phosphates, and potash, of which that which has the highest value attached to it is the nitrogen. At eleven of the stations in England and Scotland reported on in the Supplement to the *Journal of the Board of Agriculture* in 1911, linseed or cotton cake, or a mixture of these cakes, was used for two, four, or five years, and at every one of them the live-weight gain secured was insufficient to pay for the outlay, the debit balance per acre per annum being in one case nearly a pound. In connection with the improvement of pasture, however, it is the residual effect of the cake that has most interest. This matter was put to the test at eight of the manuring-for-mutton stations in the following manner. At the three original stations cake was fed all through the season for two years, and none given for the next four. At five of the other stations cake was fed for two or four years, and was then suspended for one, two, or three years. In this way the improvement of the herbage effected during the years when cake was fed had an opportunity of manifesting itself in the form of live-weight increase in the years immediately succeeding, when no cake was given. In every case the residual effect was found to be appreciable, having a money value per ton of cake consumed of as much as 4*l*. 14*s*. at one station, and 3*l*. 11*s*. at another, the average for the three stations where the residues were followed for four years being fully 3*l*. per ton, a figure which is of the same order as, though somewhat higher than, those adopted by Voelcker and Hall in their revised table of 1902.

A method of improvement of poor pasture that deserves notice consists in scattering the seed of a "renovating" mixture over the surface, usually with concurrent harrowing, rolling, and manuring. This procedure was practised in the series of experiments conducted by the Royal Agricultural Society of England, the seed mixture consisting of four natural grasses in addition to white clover and yarrow. In their final report Carruthers and Voelcker stated that

re-seeding had not been successful, a result which they thought was "entirely due to the prevalence of dry seasons, the germinating plants being killed before they could get hold of the soil." A more successful result is reported by Middleton, who on a poor pasture on clay soil in Essex sowed, in the spring of 1903, 12 lb. per acre of wild white clover seed, with and without basic slag, kainit, and lime, this treatment being unaccompanied by harrowing. There were no Leguminosæ naturally present in the field. Helped by abundant rain in the summer of 1903, the seed germinated well, and "in 1904 the results were very marked." It was, however, only when the seeding had been accompanied by basic slag that "there was the luxuriant growth which one expects in pastures where Leguminosæ are present." I also have reported on an experiment where renovating a thin, poor pasture with 6 lb. per acre of wild white clover seed was entirely successful, and here, too, the beneficial effects were only secured in the presence of basic slag.

When a responsive pasture is treated for the first time with, say, half a ton of basic slag per acre, the effects reach their maximum usually in the third season. From then onwards there is a steady diminution in the yield, though even after nine years from the time of the initial dressing the improvement is far from being exhausted. At Cockle Park, for instance, the plot dressed once with half a ton of slag was, at the end of nine years, producing three times as much mutton as the continuously unmanured ground, while at Sevington and Cransley the yield at the end of nine and eight years respectively was 70 per cent. to 80 per cent. greater. None of the other stations was carried on for so long a period, but up to the end of the sixth year most of them show residual fertility which is as great as the original rental value of the land. That is a very important result, but in the interests of the country it is still more important to endeavour to secure that the level reached at the period of maximum productivity shall be maintained.

From this rapid survey of grass-land experiments the following conclusions may legitimately be drawn:—

(1) That the quality of a pasture is not primarily dependent on its botanical composition, though, as a rule, the presence of white clover and other Leguminosæ is indicative of high feeding value.

(2) That poor pastures, especially on clay soil, can be rapidly and profitably improved by the use of phosphates, especially basic slag.

(3) That, as a rule, phosphates alone are necessary to effect and maintain the improvement, and that, of supplementary substances, potash and lime are occasionally worthy of attention.

(4) That the improvement of poor pasture is very dependent on the presence of Leguminosæ, and especially of white clover.

(5) That renovating with the seed of wild white clover may, in the absence of natural Leguminosæ, be a necessary preliminary or concurrent operation.

(6) That cake can rarely be used at a profit, and that, as an agent in improving poor pasture, it occupies an unsatisfactory position.

(7) That nitrogen, whether in the form of artificial manure or as cake residues, when added to phosphates for pasture, is always unnecessary and frequently detrimental.

(8) That in the case of hay on permanent grass-land, equal weights of produce may have very different feeding values.

(9) That few forms of agricultural expenditure are more certain in their results than the judicious use of manures on grass-land, and that the meat- and milk-producing capacity of the country can be largely and rapidly increased, with great pecuniary gain to the farmer, and still greater economic advantage to the nation.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Mr. C. Grant Robertson, tutor in modern history since 1905 to Magdalen College, Oxford, and a stimulating lecturer upon national development, has been appointed to succeed Sir Oliver Lodge as Principal of the University.

CAMBRIDGE.—Mr. K. J. J. Mackenzie has been reappointed reader in agriculture. Other appointments are:—Mr. W. J. Harrison, University lecturer in mathematics; Mr. A. Wood, University lecturer in experimental physics; Mr. A. G. Tansley, University lecturer in botany; and Mr. F. Balfour Browne, University lecturer in zoology.

DURHAM.—Members of the University are invited to help in compiling the definitive edition of the Roll of Service and Roll of Honour. The latest date for receiving forms framed to include all details of military service is December 31. The address of the University offices is 38 North Bailey, Durham.

EDINBURGH.—The University Court has made the following appointments to three newly instituted chairs:—Dr. G. M. Robertson to the professorship of psychiatry, Dr. J. H. Ashworth to the professorship of zoology, and Mr. T. P. Laird to the professorship of accounting and business method.

The following appointments have also been made:—Dr. F. E. Jardine as lecturer on applied anatomy, and Dr. David Lees as lecturer on venereal diseases.

The Right Hon. Lord Lyell of Kinnordy has presented to the geology department forty-six volumes which had formed part of Sir Charles Lyell's library when he was preparing his "Principles of Geology."

The late Mr. Samuel Elliott, of New York, has bequeathed to the University Court the sum of 1500*l.* to be held in trust by it for the purpose of applying the income in providing scholarships or prizes in connection with the classes of the professors of rhetoric and English literature and of ancient history and palæography, the scholarships or prizes to be known as the James Elliott scholarships or prizes, in memory of the testator's brother, James Elliott, who was a student and graduate of the University.

At the last meeting of the Munitions Committee, South-East of Scotland Area, a sum of 500*l.* was set aside to be expended in providing additional equipment for the engineering laboratory.

LIVERPOOL.—Mr. T. E. Peet has been appointed to the Brunner chair of Egyptology, and Dr. J. Share Jones to the chair of veterinary anatomy.

LONDON.—Dr. Sydney Russell Wells has been elected Vice-Chancellor in succession to Sir Cooper Perry, who has been appointed to the post of Principal Officer.

Sir Richard Glazebrook has been appointed to the Zaharoff chair of aviation tenable at the Imperial College of Science and Technology, founded by Sir Basil Zaharoff, who gave to the University the sum of 25,000*l.* for this purpose.

Dr. A. P. Newton has been appointed, as from September 1, 1920, the first occupant of the newly established Rhodes chair of Imperial history tenable at King's College.

Prof. W. Bulloch has been appointed, as from January 1, 1920, the first occupant of the newly established Goldsmiths' Company's chair of bac-

teriology tenable at the London Hospital Medical College.

The following doctorates have been conferred:—*D.Sc. in Applied Statistics:* Mr. E. H. Chapman, an internal student, of the Sir John Cass Technical Institute, for a thesis entitled "The Application of Statistical Methods to Meteorological Problems." *D.Sc. in Botany:* Mr. S. C. Harland, an internal student, of King's College, for a thesis entitled "Manurial Experiments with Sea Island Cotton in St. Vincent." *D.Sc. (Engineering):* Mr. N. A. V. Piercy, an internal student, of East London College, for a thesis entitled "On the Flow in the Rear of Aerofoils."

Dr. Thomas Lewis, of the cardiographic department of University College, has been awarded the William Julius Mickle fellowship, of the value of 200*l.*, in recognition of the important work which he has carried out on the nervous mechanism of the heart.

OXFORD.—Dr. F. W. Keeble, who has been elected to the Sherardian professorship of botany in succession to Prof. S. H. Vines, was formerly professor of botany and dean of the faculty of science at University College, Reading. In 1914 he was appointed Director of the Royal Horticultural Society's gardens at Wisley, and in the following year became concurrently Director of Horticulture in the Food Production Department of the Board of Agriculture. Since last year he has been Assistant Secretary to the Board.

DR. FRITZ PANETH has recently been appointed to a professorship in chemistry at the University of Hamburg, which was founded in the spring of this year. After obtaining his doctorate at the University of Vienna Dr. Paneth proceeded to England, and worked for some time in the laboratories of Prof. Soddy at Glasgow, and of Sir Ernest Rutherford at Manchester. Later he was chemical assistant in the Radium Institute at Vienna, and after the appointment of Prof. Hönigschmid to a chair of chemistry at the University of Munich in 1917, Dr. Paneth directed the work of the chemistry department of the German Technical High School in Prague.

THE University of Manchester, which before the war was preparing to issue an appeal for funds to enable it to make due provision to meet its expanding needs, has now made, in addition to that of the College of Technology, which requires 150,000*l.* for its much needed extension, an appeal for a sum of 500,000*l.*, towards which 76,000*l.* has been promised, in addition to 10,000*l.* for a chair of colloid chemistry as announced at the public meeting held in the Town Hall on December 9, to meet the urgent demands which, among other claims, the great influx of students in all departments has made upon its resources. There was recently opened a large new building for the faculty of arts (languages, literature, history, and philosophy), which, as a consequence, enables the departments of chemistry, engineering, medicine, and commerce to be accommodated more adequately. But the pressure, especially in respect of students in medicine and chemistry, and the growing need for facilities in economics, sociology, and courses of training for social work, cannot be satisfactorily met in present circumstances. A new system of post-graduate training has been instituted and a new degree therein established, which is certain to retain and attract a large body of well-prepared students to the great advantage of the University and of all concerned. The provision of hostels is an urgent need, together with that of extra-mural teaching in tutorial classes, for which there is a strong demand on the part of working men and women throughout the area covered by the University. A considerable increase in equipment, and especially in that of the teaching staff, in all departments is a pressing requirement, and altogether, having regard to the supremely and increasingly important place the University takes in the life of the city and district, makes this appeal for a large addition to its financial resources one that should commend itself to the liberal support of the great and wealthy community which it so effectively serves.

A DEPUTATION of members of the governing body of the Imperial College of Science and Technology, introduced by Lord Crewe, and received on December 15 by Mr. Balfour and Mr. Fisher, put forward the request that the college should be empowered to award degrees, either by being constituted a university or by granting its own degrees as a college. At present each of the constituent colleges of the Imperial College grants its own diplomas in the form of associateships of the Royal College of Science, the Royal School of Mines, and the City and Guilds' Institute respectively, while the Imperial College itself awards a diploma for a course of advanced work. There is, however, a great difference in the market values of a diploma and a degree, and it is on this account that the movement to make the college a degree-conferring institution has the support of most past and present students. The question of constituting another university in London has already been considered by two Royal Commissions and adversely reported upon, and the demand for the foundation of the new university will need to be strongly supported before it can have the promise of success in the face of these two reports and of the certain opposition of London University. The simplest course, and the one that would arouse least opposition, would be to grant the college the power of conferring degrees. Whichever plan is adopted, it is to be hoped that the position of past students of the constituent colleges will be effectively safeguarded. We assume that, whether the Imperial College grants a degree or a diploma, adequate provision will continue to be made for the study of pure science. It is becoming increasingly difficult to obtain the necessary funds for carrying on scientific research not directly concerned with industry, and the neglect of this part of the work of the college would eventually have a disastrous effect on technical education and industrial progress. A strong case can, no doubt, be made out for several distinct universities in London, and the appeal made on behalf of the Imperial College has been followed by a letter from Profs. W. H. Bragg and E. H. Starling in the *Times* of December 22, in which like claims are made for the freedom of King's College and University College "as regards teaching, research, and the granting of degrees."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 11.—Sir J. J. Thomson, president, in the chair.—C. F. U. **Meek**: A further study of chromosome dimensions. The degree of somatic complexity of an animal cannot be correlated with (*a*) the lengths of the chromosomes composing its complex; (*b*) the diameters of the chromosomes composing its complex; (*c*) the total volume of the chromosomes composing its complex; and (*d*) the number of the chromosomes composing its complex. There are many different chromosome diameters. The chromosomes composing the spermatogonial complex of an animal are not necessarily identical in

diameter with those composing its secondary spermatocyte complex. All chromosomes composing an individual complex are not necessarily of the same diameter.—J. M. H. **Campbell**, C. G. **Douglas**, and F. G. **Hobson**: The respiratory exchange of man during and after muscular exercise. Support is given to the view that muscular work may involve the metabolism of a higher proportion of carbohydrate to fat than is the case during rest. In the case of the severer degrees of work, serious shortage of oxygen, as indicated by the production of lactic acid, may lead in the earlier stages of the exercise to temporary great exaggeration of the hyperpnœa, accompanied by washing out of preformed CO_2 from the body and an abnormally high respiratory quotient, phenomena which are absent in the case of lighter work.—A. D. **Waller**: The energy output of dock labourers during heavy work. Part i. The paper contains the results of observations on dock labourers by a simplified method, which consists in measurements of the CO_2 discharge at convenient intervals throughout the working day or night with the least possible interruption of work.—J. **Gray**: The relation of spermatozoa to certain electrolytes (ii.). The paper embodies an attempt to apply the facts of recent chemistry to the behaviour of the living cell.

Royal Anthropological Institute, December 9.—Sir Everard im Thurn, president, in the chair.—J. H. **Hutton**: Leopard-men in the Naga Hills. The Naga tribes generally regard the tiger as having the same origin as man, in that the first tiger and the first man were brothers, sons of one mother. No clear distinction is drawn between leopards and tigers, the same word being ordinarily used for both animals. The practice of lycanthropy among the Naga tribes differs from that followed in India, Burma, and Malaysia, in that no actual metamorphosis is believed to take place, in which respect it seems to differ from the form which lycanthropy takes in most parts of the world. The Naga method is to project the soul from the human body into the body of a leopard, usually, but not necessarily, during sleep. By this process the two bodies become intimately associated, and violent emotions affecting the one body are perceptible to the other. On the death of one, the other dies. The acquisition of the powers of a lycanthropist is not desired, but feared and disliked. The practice is assumed involuntarily at the dictation of spirits whose will the subject of it is more or less powerless to resist. The closest parallel to the Naga practice seems to be found in Nigeria, where there are beliefs ("Golden Bough," vol. ix.) which resemble those of the Naga tribes closely. In the Naga Hills and Assam this particular form of lycanthropy seems to be connected with migration from the north as distinct from other immigrations from the east and south.

Linnean Society, December 11.—Dr. A. Smith Woodward, president, in the chair.—Prof. W. A. **Herdman**: Notes on the abundance of marine animals and a quantitative survey of their occurrence. On a former occasion the author considered the plankton food-supply of edible fishes for the purpose of showing the fundamental importance of a very few organisms, about half a dozen kinds of diatoms and the same number of Copepoda. In the present paper he extended the same conclusions to the shallow-water and littoral common animals which are the food of our bottom-feeding fishes.—J. B. **Gatenby**: The germ-cells and early development of *Grantia compressa*. The spermatids of Grantia are described for the first time. They lie inside chambers formed of mesogleal cells. The mitochondria (chromidia) and Golgi apparatus of oocytes and other cells are described.

MANCHESTER.

Literary and Philosophical Society, December 2.—Prof. F. E. Weiss, deputy chairman, in the chair.—C. E. **Stromeyer**: A method by which roots of numbers can be easily and rapidly found by division sums.—L. V. **Meadowcroft**: A discussion of the theorems of Lambert and Adams on motion in elliptic and hyperbolic orbits. Lambert's theorem (1761) on the motion of a body in an elliptic orbit, under the influence of a central gravitational force, can be stated in the following purely geometrical form. The area of any focal sector of an ellipse can be expressed in terms of the focal distances of its extremities, of the chord which joins them, and of the axes of the ellipse. To J. C. Adams is due the most elegant form of the proof. The present author shows that this can be translated from analytical into geometrical terms. An independent proof based on geometrical considerations is thus suggested. Such a proof is given, and also an analogous proof for the corresponding theorem on the area of a focal sector of a hyperbola.—W. E. **Alkins**: Morphogenesis of *Reticularia lineata*. After a *résumé* of earlier work (including Day's) on variation in Brachiopoda, by using Day's specimens the author had constructed skeleton solid figures showing the distribution of length and width, and of length and depth, among 945 individuals of *Reticularia lineata*, Martin, from a restricted locality in the Carboniferous Limestone of North Derbyshire. Day's conclusions were confirmed. The ratio of width to length and of depth to length throughout the series showed that in the development of the individual shell the width and length were connected by a linear function, whereas the depth and length, though related by a linear expression up to a certain size, were connected by a logarithmic function over the greater portion of the range covered by the specimens. The transition from the linear function to the logarithmic relationship was perfectly gradual and continuous.

DUBLIN.

Royal Dublin Society, November 25.—Mr. R. Ll. Praeger in the chair.—T. G. **Mason**: Electrolytes in the leaf-sap of *Syringa vulgaris*. Determination of the dissolved electrolytes of the cell by means of conductivity measurements is largely vitiated by the influence of the viscosity of the solvent. Correction by means of direct measurement of the relative viscosity of the sap is shown to be unsatisfactory. By introducing a known concentration of an electrolyte into the sap and by comparing its conductivity in the sap with that in water, it is possible to obtain a closer estimate of the amount of electrolytes in the sap corresponding with the observed conductivity of the sap. Fluctuations in the electrolyte content of the sap appear to be in the inverse sense of those of the soluble carbohydrates. It is suggested that the concentration of the dissolved electrolytes may be directly or indirectly controlled by the osmotic pressure of the sap.—L. B. **Smyth**: The Carboniferous coast section at Malahide. Between Malahide and Portmarnock, Co. Dublin, an outcrop of Carboniferous Limestone rocks occurs, extending for about a mile along the sea-shore, and having a general dip to the north. This exposure was mapped by the Geological Survey. One fault was shown, separating a smaller southern portion from the rest. This southern part was considered to be older than the remainder, and to have been brought *up* by the fault. It was assigned, chiefly on lithological grounds, to the Lower Limestone Shales. The author maintains, on both structural and faunal grounds, that it is really the youngest part of the section, and belongs to Vaughan's "C" zone, the part north of the fault being assigned to the "Z" zone

and the base of "C." The throw of the fault was estimated to be at least 780 ft. Two other faults are pointed out. One, in the middle of the exposure, causes a repetition of "Z" beds, and has a downthrow of 330 ft. to the south. The other, to the north of this, throws in the opposite direction, and is probably slight. Three new species of corals are described of the genera Michelinia, Zaphrentis, and Endophyllum.—J. J. **Dowling**: An apparatus for the production of high electrostatic potentials. The apparatus is an influence machine which transforms a battery voltage of, say, four hundred to, say, five hundred volts. The ratio of transformation can be adjusted, and the high potentials are remarkably steady. An earthed disc is carried to and fro, being fixed to the end of a rod which is given a reciprocating motion by an eccentric device. A contact-maker is mounted on the eccentric shaft, and this alternately connects a fixed insulated disc, mounted opposite the earthed disc, alternately to the battery and to the apparatus which is to be maintained at the high potential. One pole of the battery is, of course, earthed.

BOOKS RECEIVED.

A Short History of Education. By Prof. J. W. Adamson. Pp. xi+371. (Cambridge: At the University Press.) 12*s.* 6*d.* net.

Malleable Cast-Iron. By S. J. Parsons. Second edition. Pp. xi+175. (London: Constable and Co., Ltd.) 14*s.* net.

Les Grottes de Grimaldi (Baoussé-Roussé). By Prof. M. Boule. Tome i., Fasc. iv.: Géologie et Paléontologie (Fin). Pp. 237–362+plates. (Monaco.)

An Introduction to Social Psychology. By Dr. W. McDougall. New edition. Pp. xxiv+459. (London: Methuen and Co., Ltd.) 7*s.* 6*d.* net.

Nationality and Race: From an Anthropologist's Point of View. By Prof. A. Keith. Pp. 39. (London: Oxford University Press.) 2*s.* net.

Mesures Pratiques en Radioactivité. By Drs. W. Makower and H. Geiger. Traduit de l'Anglais par E. Philippi. Pp. vii+181. (Paris: Gauthier-Villars et Cie.) 8 francs.

Aircraft in Peace and the Law. By Dr. J. M. Spaight. Pp. viii+233. (London: Macmillan and Co., Ltd.) 8*s.* 6*d.* net.

An Introduction to Anthropology. By Rev. E. O. James. Pp. ix+259. (London: Macmillan and Co., Ltd.) 7*s.* 6*d.* net.

Psychology of the Normal and Subnormal. By Dr. H. H. Goddard. Pp. xxiv+349. (London: Kegan Paul and Co., Ltd.) 25*s.* net.

Lectures on Industrial Psychology. By B. Muscio. New edition. Pp. iv+300. (London: G. Routledge and Sons, Ltd.) 6*s.* 6*d.* net.

Fuel, Water, and Gas Analysis for Steam Users. By J. B. C. Kershaw. New edition. Pp. xii+201. (London: Constable and Co., Ltd.) 12*s.* 6*d.* net.

The Aviation Pocket-Book for 1919–20. By R. B. Matthews. Pp. xxiv+536. (London: Crosby Lockwood and Son.) 12*s.* 6*d.* net.

Outlines of the History of Botany. By Prof. R. J. Harvey-Gibson. Pp. x+274. (London: A. and C. Black, Ltd.) 10*s.* net.

The Preparation of Organic Compounds. By E. De Barry Barnett. New edition. Pp. xv+273. (London: J. and A. Churchill.) 10*s.* 6*d.* net.

A Treatise on Qualitative Analysis. By Prof. F. Clowes and J. B. Coleman. New edition. Pp. xvi+400. (London: J. and A. Churchill.) 12*s.* 6*d.*

Elementary Practical Chemistry. By Prof. F. Clowes and J. B. Coleman. New edition. Part i.: General Chemistry. Pp. xvi+241. (London: J. and A. Churchill.) 6*s.*

Modern Spiritism: Its Science and Religion. By Dr. A. T. Schofield. Pp. ix+259. (London: J. and A. Churchill.) 3*s.* 6*d.* net.

Die Stämme der Wirbeltiere. By Prof. O. Abel. Pp. xviii+914. (Berlin and Leipzig: W. de Gruyter and Co.) 56 marks.

DIARY OF SOCIETIES.

MONDAY, DECEMBER 29.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 3.30.—Mrs. Dickinson Berry: Serbia and Yugo-Slavia, Before the War and After (Christmas Lecture to Young People).

TUESDAY, DECEMBER 30.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. W. H. Bragg: The World of Sound, I., What is Sound? (Christmas Lectures).

THURSDAY, JANUARY 1.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. W. H. Bragg: The World of Sound, II., Sound and Music (Christmas Lectures).

FRIDAY, JANUARY 2.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 3.30.—Miss Hilda Bowser: A Visit to the Diamond Mountain in Korea (Christmas Lecture to Young People).

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—A. P. Morris: Burmese Village Industries: Their Present State and Possible Development.

SATURDAY, JANUARY 3.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. W. H. Bragg: The World of Sound, III., Sounds of the Country (Christmas Lectures).

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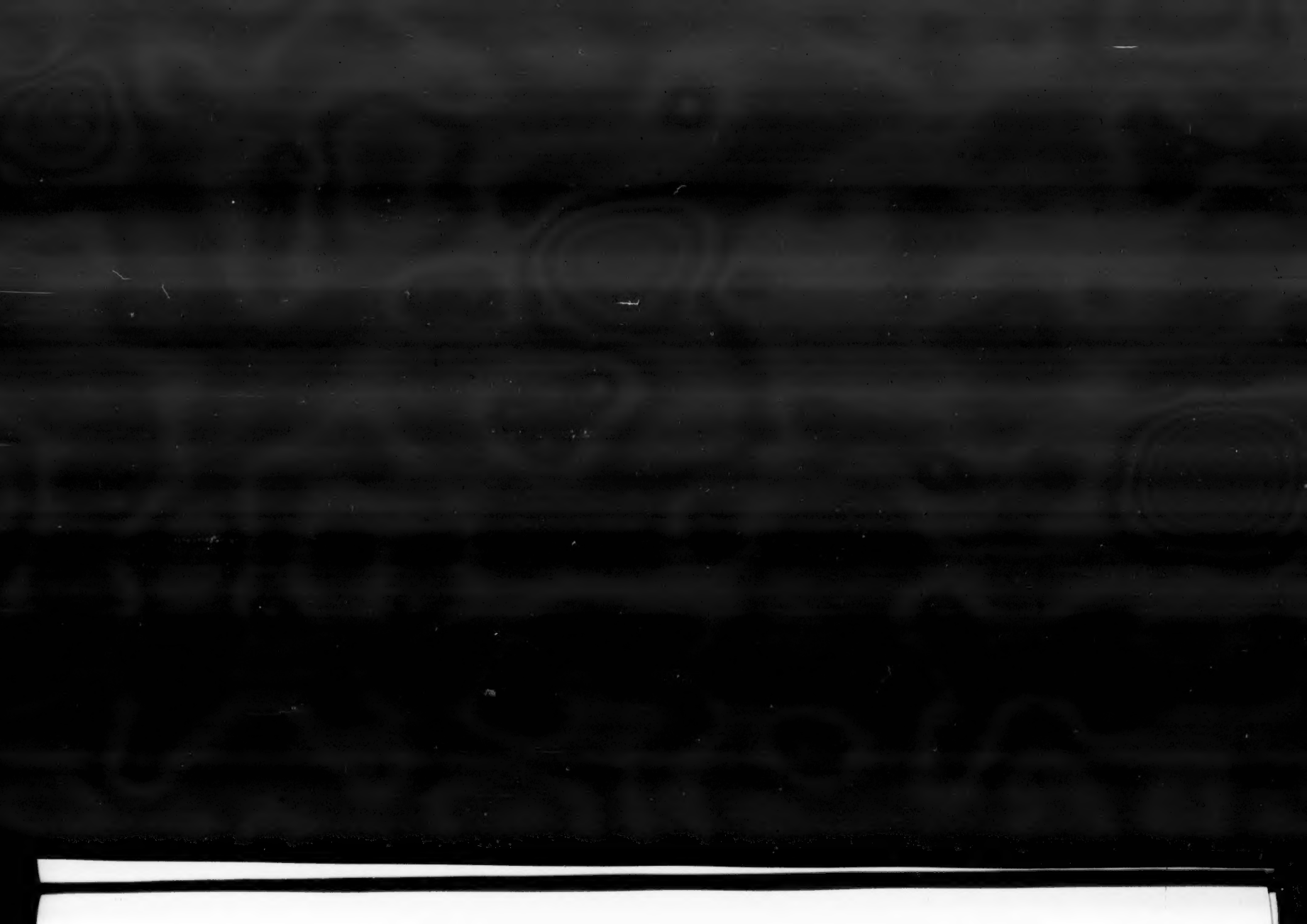
Editorial and Publishing Offices:

MACMILLAN AND CO., LTD.,

ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.

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